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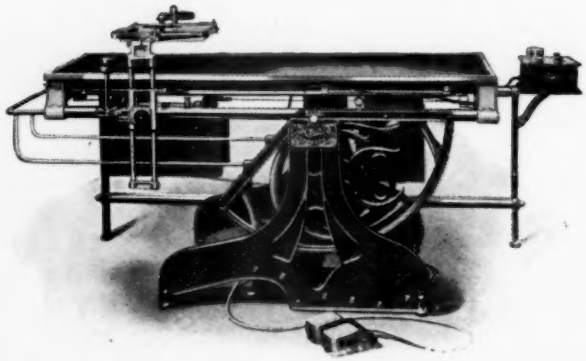

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THE AMERICAN JOURNAL OF ROENTGENOLOGY

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ADDRESS OF WELCOME*

By WILLIAM J. MAYO, M.D.

ROCHESTER, MINNESOTA.

MR. CHAIRMAN, Members of THE AMERICAN ROENTGEN RAY SOCIETY: I do not propose to take up your time in exactly the way your President has outlined, but rather to call attention to some of the important facts in connection with the specialty you gentlemen represent. I am free to say that the profession as a whole appreciates how much roentgenology is doing for the advancement of medical diagnosis.

Medicine has ever advanced under the sense of sight. In the operating room of Gray Turner, one of the brightest and most progressive younger surgeons of Great Britain, hangs a motto. At the top of this motto in large letters is the word "sight." Below in small type, "touch," and down at the bottom so it can scarcely be seen, "hearing." These three senses seem really to represent the manner in which we learn; the reason for it is simple.

The first of the special senses was the sense of taste which enables the primitive mouth to recognize food. Then came the sense of smell, that the mouth might be brought to recognize food with which it was not in contact. Both these senses are poorly developed in man. Then, for the protection of the living body, came hearing, and because dangers presented from behind, and from each side, as well as in front, the ears were placed on the sides of the head. In hearing man does not excel, in fact, he does not in this respect equal many of the so-called lower animals. But when the brain began to develop in man, it was with the development of the sense of sight, so that there are direct channels from all parts of the brain to the sense of sight. With most of us memory is visual. We reproduce in our minds the photographic picture of what we wish to remember. I can illustrate this by something I observed many years ago at a party given by my daughter, then eight years of age. A child was blindfolded, and two pieces of metal were struck together about eighteen inches from her head. I was amazed that the child could do no more than make a guess with regard to the direction of the sound. Children blindfolded could not distinguish a brother from a sister by passing hands over the face, thus showing the inaccuracy of the senses of hearing and touch.

Great advances in medicine were made

*Read at the Twenty-first Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Rochester, Minn., Sept. 14, 1920.

by John Hunter, who with the aid of a primitive microscope reconstructed pathology. Following John Hunter, through the sense of sight and aided by the improved microscope and the culture tube, Pasteur developed the germ theory of disease which has brought us to the point where we are to-day.

The surgeon, when he explored the abdomen, brought to his aid the sense of sight, so that things otherwise obscure might be made known. It is the sense of sight that has permitted specialists in their study of the urogenital system to accomplish what they have. Roentgenologists have opened a new door through which we are to see things that never before have been seen by man.

In our appreciation of the *x*-ray I believe we have been led by the splendid work that was done by Roentgen to overlook the wonderful work of Sir William Crookes, but, it will be remembered that it was with Crookes' tubes that Roentgen worked. Crookes, with his heavy glass bulb exhausted the air and then made the electric attachments that gave us the *x*-ray. He saw atoms in action, and, as he says, "For the first time, we have reached the point in which we no longer can separate energy from matter."

I believe that we are in the primary stage, the infancy, of the *x*-ray. Its future is limitless. The *x*-ray extends man's capacity, it extends his understanding, because it produces pictures in his mind which he visualizes more clearly from day to day.

Because of our desire to apply to the diagnosis of disease the knowledge and the methods of all specialists we are practicing group medicine. Group medicine consists in giving to the sick the knowledge, skill, and experience possessed by the medical profession in common and by specialists.

One of the buildings in the course of construction in Rochester will be used for the purpose of maintaining 250 beds in which patients will be treated whose diagnosis is doubtful or in whom the indications for treatment are not clear, thus bringing to bear on their infirmities not merely the internist, the surgeon and the specialist, but all that physiology, bacteriology, physics, chemistry, and pathology have to offer by learned men in these sciences.

ADDRESS OF WELCOME*

By CHARLES H. MAYO, M.D.

ROCHESTER, MINNESOTA.

IT is certainly a great pleasure to have you gentlemen stop off in Rochester on your way to your meeting place, and we who are not roentgenologists hope to learn a great deal even during your short stay.

There is something magnificent about the work in electricity, and yet it is only in its infancy. When we remember how much of benefit to the human race the *x*-ray has accomplished in a few decades, we may well wonder what the future has in store for a science that is so constantly and rapidly progressing. In the development of roentgenology a new branch has been established in medicine, thus aiding and encouraging departmental work in the diagnosis of disease.

The thought I wish to bring to your at-

*Read at the Twenty-first Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Rochester, Minn., Sept. 14, 1920.

tention at this time is the fact that even though you are engaged in the highly specialized work of roentgenography, you nevertheless have a share in the responsibility, with all other medical men, of elevating the standards of medicine in general and of working along the lines of the prevention of disease. The best men in every town or city, no matter what their specialty may be, should interest themselves in public health measures. A medical man should be on the school board in every community; a medical man should be in every city council; a medical man who ignores these duties is not serving his own interests, the best interests of the profession, and certainly not the best interests of the community in which he lives.

ROENTGENOLGY IN THE MAYO CLINIC*

By R. D. CARMAN, M.D.

Section on Roentgenology, Mayo Clinic,

ROCHESTER, MINNESOTA.

IN the time allotted to this paper I can describe briefly only some of the technique employed in the *x*-ray laboratory. Roentgenology as practiced in the Mayo Clinic differs little from that practiced elsewhere. The most striking differences lie in:

1. The wealth of material available in the Clinic.
2. The simplicity of technique and the dispatch of examinations.
3. The organization and close affiliation with all other departments of the institution.
4. Surgery that proves or disproves the roentgen findings.
5. The making of a diagnosis, or description of a lesion or abnormality, when present, uninfluenced by clinical findings.
6. Uniformly arranged records covering every eventuality.

During the year 1919 the examinations made in the Department of Roentgenology numbered 50,668 as follows: kidney, ureter and bladder, 6,088; bone 12,129; chest, 17,301, and gastro-intestinal tract 11,825. In the Department of Urology 1325 pyelograms were made.

In regard to technique the effort has been toward simplicity, not, however, to the exclusion of anything essential. For example, in the examination of the urinary tract 8 by 10 inch plates are used with a core for compression having an aperture of 5 inches. The position of the plates is such that each exposure slightly overlaps the preceding exposure. To illustrate: One plate is used for each kidney area, one for the ureters high up, and one for the lower ureters and bladder combined. In thin persons, however, where there may be a movable kidney a 10 by 12 inch plate is substituted for the ureters. This exposure is made with a cone having a 7½ inch aperture.

All chest examinations are made stereoscopically with the patient standing and the plates shifted in the vertical position. If indicated, patients are also subjected to screen study.

Preliminary preparation of the gastro-intestinal tract is assured by written instructions issued to the patient by the referring clinician. The majority of patients come directly from the gastro-enterologist, after tubing and lavage which insures thorough evacuation of food bite and secretion in obstructive cases.

In esophageal examinations the patient is placed in the right anterior oblique vertical position; plates are made in the same posi-

*Read at the Twenty-first Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Rochester, Minn., Sept. 14, 1920.

tion with the patient either recumbent or standing. The barium acacia mixture is used in this examination.

The double meal method is used in all gastric examinations, that is, the patient is given a motor meal, four ounces by weight, consisting of barium sulphate cooked in a cereal. This is taken with milk and sugar to taste six hours before the examination is made. During the intervening six hours the patient must, of course, abstain from food.

The examination consists of observation of the chest, after which the screen is lowered over the abdomen to note if there is residue in the stomach or obstruction in the small bowel, and so forth. The patient is then given an aqueous mixture of four ounces of barium sulphate, one dram of sodium bicarbonate, eight ounces of water, and syrup of raspberry sufficient to flavor; this is thoroughly mixed by a motor driven machine for from two to four minutes before taken.

While the patient is drinking this mixture the stomach is viewed to detect abnormalities. When the entire draught has been taken the stomach is palpated for possible tumors, the barium is forced into the duodenum to overflowing and any irregularity of contour is noted. Plates are made immediately after the screen examination and the diagnosis is made by comparing the plate and the screen findings. The patient does not return for further examination unless obstruction of the bowel is suspected or the findings suggest further study.

For the examination of the colon the patient has a preliminary purging by castor oil the day before examination and a cleansing enema early the next morning. Our preference at present is for the enema, as we believe that any lesion demonstrable by the ingested meal is equally well demonstrated by the enema, and that many early lesions not demonstrable by the ingested meal can be recognized by the clysma.

The enema consists of from six to eight ounces of barium sulphate, one pint of saturated solution of acacia, and condensed milk to make three quarts. An ordinary metal douche-can of this cacapity is suspended at an average height of 12 inches from the table connected by rubber tubing to a metal rectal tip which has just sufficient shoulder to insure its retention by the sphincter. A number of these are kept in the sterilizer and a fresh tip is used in each examination.

The patient lies on his back and a preliminary screen examination is made for evidence of any pathologic conditions. The enema is administered slowly and its progress is watched for filling defects. The patient's deep breathing assists in the passage of the fluid, especially in the region of the cecum and ascending colon. The fluid is allowed to flow until it is seen to pass the ileocecal valve. Areas of apparent filling defects are palpated deeply to rule out gaps from small gas-pockets, bone pressure, redundant loops, and so forth. Placing the patient in the prone position will often clear up an apparent filling defect. Plates are made with the patient on his back and in the prone position. The personnel of the department consists of a head, an associate, assistants, technicians, and clerks. A limited number of Fellows from the Mayo Foundation, which is affiliated with the graduate school of the University of Minnesota, are assigned to the department for duty for periods ranging from three months to the full term of three years.

Reports on the examinations of patients are delivered twice daily and a messenger service is maintained to deliver plates, on request, to any hospital or department of the clinic. View boxes have been placed in most of the departments, and clinicians frequently come to the roentgen laboratory to discuss findings.

Through the universal use of the patient's registration number on all records in the clinic, the correlation of clinical and laboratory findings is easily effected. In the study of the material constantly passing through the department all the information concerning an individual patient is placed in the general file with every facility to make it avail-

able. Statistical files covering many phases of medicine and surgery are maintained.

It has been the practice of the department for many years to have one member of the staff, usually the head, attend operations examined in the department. This offers an opportunity to compare the clinical history as it is read in the operating theater with the roentgen diagnosis and then to learn the operative findings. By this method we have been able to work out indirect signs which in our experience have proved as valuable as the direct signs in making a diagnosis and have also added materially to our knowledge of and confidence in the latter.

We must acknowledge here the splendid cooperation of the surgeons; without their skill, their experience, and their belief in the value of the *x*-ray much of the best of our work would have been impossible of achievement.

Typewritten copies of the surgical findings in all cases in which we have an interest are furnished the department to be added to its records.

The patient comes to our department with a referring card on which, in the majority of cases, is stated the examination required; a few of the cards may have a brief note on clinical findings; however, the roentgen diagnosis is made without reference to these clinical notes. When possible the diagnosis is made on roentgen signs, but in atypical cases only the character of the lesion or the abnormality is described.

While this independent method of examination has resulted in greater accuracy in the diagnosis of gastro-intestinal diseases because of the various influences affecting the gastro-intestinal tract, such as spasm, tonus, fright, anger, or muscular contraction, it does not hold true of other parts of the body where these influences cannot be brought to bear. Here we may use the clinical data in combination with the roentgen observations to form (1) a general syndrome on which the diagnosis is based; (2) as an index of the possibilities and probabilities in the case at hand and thus direct the examiner's particular attention to them, and (3) to prevent too hasty judgment, as in those cases in which the roentgen signs do not harmonize with the clinical facts, and in which a more careful review of these signs or a re-examination may show them to have been mistaken.

GRADUATE EDUCATION IN ROENTGENOLOGY*

By LOUIS B. WILSON, M.D.

The Mayo Foundation,

ROCHESTER, MINNESOTA

YOUR president has asked me to speak on graduate education in roentgenology. As Chairman of the Committee on Graduate Medical Education of the Council on Education of the American Medical Association last winter I assisted in the investigation of graduate medical schools east and south of Minnesota. This investigation brought out certain facts which, with the results of our experience in the Mayo Foundation, may be of interest to you.

I think we may take it for granted that before beginning the special study of roentgenology a man should be thoroughly grounded in the fundamental medical sciences, chemistry, anatomy, physiology, pathology and bacteriology, that he should have had general training in clinical medicine, especially in clinical diagnosis, indeed a minimum of what is implied by graduation from a class A medical school, and at least one year's work in a good general hospital. Such a preliminary training would mean that the average person would be twenty-eight years of age before taking up his special training in roentgenology. He is then of course too old. Unless boys can get into college earlier there seems to be no way out of this dilemma.

Fellows in the Mayo Foundation who are selected with this preliminary training are found to be fairly well grounded in general medical work. They are likely to have been taught anatomy more from the purely morphologic standpoint than the functional, to be wofully inexperienced in performing necropsies, and to have little ability to marshall their knowledge of the several fields of medicine and make it available in finding out what is the matter with the patient. This latter defect may be due to the "air-tight-compartment" system of medical training by which each instructor imparts his subject without sufficient reference to other departments, while the student is not encouraged to discover the relationships between courses and their bearings on disease in the individual patient. Many of the men have more receptivity than initiative, the result of being taught too much and not having been permitted to find out enough for themselves. And, yet, initiative is a prime requisite of leadership in any field of medicine.

The first essential then in training such a graduate medical student in roentgenology or any other medical specialty is to throw him on his own responsibility and compel him to learn to utilize all his powers in diagnosis and treatment. To do this he must be placed in contact with patients and be made responsible for the diagnosis of their ailments. He must be made to dig rather than be crammed. His first work will probably be very superficial, and he must be compelled to be thorough. If serious defects in his preliminary training in any of the fundamental branches are discovered he must have an opportunity to remedy them. While his routine clinical work must be sufficient to give him good experience it must not be so much as to wear him out with the mere physical labor of it. He must be given time to think, to organize his observations, not on one patient alone but on groups of patients, so that he may get a scientific viewpoint of the conditions of disease. He must learn also how to analyze the observations of others, either his immediate associates or those with whom he becomes acquainted in the literature. In other words, he must become an observer who makes science of his observations.

Last, but not least, he must be relieved from serious financial worry while in training. Few graduate medical students are

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wealthy. Many of the more brilliant are already in debt. That distinctions should not be obvious all should be paid a living stipend. This will go far toward preventing the tendency to the "quick lunch counter" methods of short courses of a period which we hope is passing.

We are taking on a limited number of Fellows in the Mayo Foundation for training in roentgenology. Dr. Carman has opportunities for four such Fellows at one time in addition to those majoring in other clinical subjects who wish to take advantage of the demonstrations and instruction provided in the department. Forty-seven Fellows are taking roentgenology as their minor. Most of the Fellows majoring in roentgenology are taking morbid anatomy as their minor subject, which means that they spend about six months on the necropsy service during which time they personally assist in about 150 postmortems. One of the Fellows has spent some time in Cambridge, England, working on the physics of *x*-ray. The bulk of the time of Fellows majoring in roentgenology is spent in the *x*-ray diagnostic work, some in *x*-ray treatment, and some in radium treatment. Clinical demonstrations in the various diagnostic and laboratory sections are open to them. The extensive material in the pathologic museum, all of which is card-indexed and made easily available, is at their disposal for special study; so also are the histories and statistical data in the divison of records. The study and reference library is on the floor above the *x*-ray department and all graduate students are encouraged to familiarize themselves with the literature of their special field which is reviewed in the seminar of the department. Numerous opportunities are afforded for following patients to the operating rooms where *x*-ray diagnoses may be checked.

At the end of a minimum period of three years, the Graduate School Committee, which consists of representatives from the faculties of the Medical School of the University of Minnesota and of the Mayo foundation, all of whom take part in testing the candidate, may recommend him to the Board of Regents of the University of Minnesota as qualified to receive the degree of Master of Science in Roentgenology.

The basis of the candidate's recommendation is the evidence given during the three years in the Foundation that he is, first, a competent practitioner of roentgenology, second, that he has a mind capable of organizing his daily observations into scientific form, and, third, that he has a broad knowledge of the facts of roentgenology and the supporting fields of medicine. The standard by which his competency as a practitioner of roentgenology is measured is the certification of the roentgenologists with whom he has worked that they are willing to call him in consultation and to refer cases to him, indeed that they are willing to refer their own relatives to him for professional service. This is the most important test of his qualifications. He must show that he has a scientific mind by a properly prepared thesis, containing his analysis of a group of cases which he has had under observation in the Clinic, supplemented by an analysis of observations of other cases of similar kind recorded in the case histories of the Clinic or in the literature. His knowledge of the facts of roentgenology and supporting fields of medicine is tested by very thorough oral and written examinations.

The degree of Doctor of Philosophy in Roentgenology is reserved for those exceptional graduate students who have proved in addition to the qualifications required for the degree of Master of Science their special capacity for research work of a high order.

The attempt to put graduate work in roentgenology and in other fields of medicine on a university basis has now been in progress in the University of Minnesota for six years. The plan is not perfect, but it is being improved with experience, and we have unquestioning faith that if other universities follow the plan it will work out well in the end, and place all fields of graduate work in medical specialties on a much higher plane than they are at present.

TOPICAL APPLICATIONS OF RADIUM*

By H. H. BOWING, M.D.

Section on Radiotherapy, Mayo Clinic

ROCHESTER, MINNESOTA.

IN our application of radium in the Mayo Clinic we use the terms milligram hour, erythema dose, distance screening, and so forth.

Milligram hours must be defined in each case. The amount of radium used multiplied by the hours applied gives the number of milligram hours. Applying 50 mg. of radium for twenty hours is not the same as applying 20 mg. for fifty hours, although the total of milligram hours is the same.

The term erythema dose represents 1000 mg. hours of radium, delivered to a square inch of skin surface at one inch distance, filtered through the silver wall of the applicator and 2 mm. of lead. The universal round applicator containing 50 mg. of radium screened with 0.5 mm. of silver and 2 mm. of lead at one inch distance applied for twenty hours is considered an erythema dose. In the majority of cases no erythema develops. The erythema which occurs occasionally is transient. It usually responds readily to simple treatments.

The term "distance screening" indicates that some substance, such as cork, wood or gauze, has been interposed between the radium and the skin surface overlying the area to be radiated. The distance bears a relationship to the amount of radium used and the distance of the lesion beneath the surface of the skin.

Cancer of the breast, primary and secondary sarcoma, Hodgkin's disease, tuberculous adenitis, and splenomyelogenous and lymphatic leukemias respond to topical applications of radium and deep *x*-ray therapy.

Cancer of the Breast.—In treating a primary carcinoma of the breast with or without metastasis a thorough radiation is indicated before operation and radiation after operation as soon as convalescence permits. Patients in this group have received repeated radium and *x*-ray treatments when a general anesthetic was contra-indicated owing to some myocardial change, thoracic or renal complication. Our cases in this group are too few for statistical study, but the primary results are encouraging.

All patients with recurring carcinoma of the breast with or without metastasis improve under this treatment, at least ulceration and sloughing are prevented. Roentgenograms of the chest are taken before treatment in order to determine the depth of the metastasis.

An erythema dose is delivered to each square inch of skin surface overlying the primary or secondary growth. Should the area be less than one inch square, 500 to 900 mg. hours are given. The treatment is repeated every six weeks until no evidence of activity is demonstrable.

X-ray treatment is repeated every three weeks until eight or ten have been given; after a wait of three months it is determined whether further therapy is needed. In possible metastatic areas *x*-ray therapy is given.

Sarcoma.—The round-cell sarcoma responds very readily and the melanotic sarcoma very poorly to radium and *x*-ray therapy. The spindle-cell and giant-cell sarcomas respond more favorably than the melanotic type. In a majority of cases it is possible to treat only the secondary growth.

The involved areas are mapped out and an erythema dose of radium is applied to each square inch of skin surface. If the involvement is confined either to the chest cavity or to the abdominal cavity, radium is applied to the anterior surface of each and deep *x*-ray therapy is given through the posterior and lateral abdominal and thoracic walls by the cross-fire method. The com-

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bined treatment is repeated at intervals of three months if necessary.

Hodgkin's Disease.—The treatment of the acute and chronic cases of Hodgkin's disease is identical. The first type is less amenable to treatment on account of its rapid clinical course. The majority of the patients are treated for cervical, supraclavicular, axillary and inguinal glandular involvement with or without splenic enlargement. Roentgenograms are taken of the chest, abdomen and pelvis to ascertain the amount of involvement of the deep lymphatics.

Superficial lymphatic enlargements are mapped out and an erythema dose of radium delivered to each square inch of surface. If the nodules are discrete and small, 500 to 900 mg. hours of radium with distance screening are applied to the enlarged node. If there is splenic enlargement, six areas are mapped out over the splenic area and 50 mg. of radium in a universal round applicator screened with 2 mm. of lead at one inch distance are applied for periods of four hours each. If the roentgenogram shows involvement of the thoracic, abdominal, and pelvic lymphatics, deep *x*-ray therapy is applied in the respective areas.

Tuberculous Adenitis.—The simple type of tuberculous adenitis offers the best result. If suppuration is present, curetting or drainage may be necessary. The patient is supported with general hygienic and dietary measures. Hyaline or calcarious adenitis may be an end result following radiation.

An erythema dose of radium is applied to each square inch of surface covering the enlarged lymph nodes. Should the nodes be discrete and enlarged, 500 to 900 mg. hours of radium are applied. The dose is determined by the size of the nodes. The treatments are repeated every six weeks until all signs of activity have disappeared.

Leukemia.—More radium is given in cases of acute splenomyelogenous leukemia than in the chronic cases in order to put the patient in the chronic state as rapidly as possible. Satisfactory remissions are obtained in practically all cases.

The amount of radium used is 100 mg. in the acute cases and 50 mg. in the chronic cases. The radium is placed in a universal round applicator walled with 0.5 mm. of silver, with 2 mm. of lead as a filter at one inch distance. Six to eight areas are mapped out over the area of lymphatic or splenic enlargement. The time of each application is four and three hours, respectively. The treatment is repeated at weekly intervals until a series of three or four have been given. During the treatments the blood is examined. If the hemoglobin and red cells decrease, the treatment is discontinued and a six weeks' rest is given. All patients are supported medicinally. Dietary measures and daily activities are also controlled.

ROENTGEN EXAMINATION OF THE URINARY TRACT MADE OPAQUE*

By W. F. BRAASCH, M.D.

Section on Urology, Mayo Clinic,

ROCHESTER, MINNESOTA.

VOELCKER and von Lichtenberg first demonstrated, in 1906, the feasibility of outlining the renal pelvis in the roentgenogram by injecting the pelvis with an opaque medium. The value of this method was not appreciated, however, until several years later, when American observers developed the method to its present scope, and subsequently it was widely adopted.

The procedure was first used to outline the pelvis, later the ureter, bladder, and urethra. With the increase of the scope of the method, the original term of pyelogram became manifestly insufficient. As a term which will represent the roentgenographic demonstration of the entire urinary tract I should like to suggest "urography." Such a term would not interfere with the retention of the accepted terms referring to the different areas, namely pyelography, ureterography and cystography.

Urography entails unusual and highly specialized technical difficulties, and unless judicially employed it is not without great danger to the patient. Its use should, therefore, be confined only to the experienced urologist and roentgenologist, working in close cooperation. Furthermore it should be used only when the clinical diagnosis cannot be made without it. Urography is contraindicated (1) when the patient is in advanced age or greatly emaciated, (2) in cases of advanced bilateral renal disease, and (3) when it is apparent that surgical treatment will be of no benefit.

Extensive improvements have been made in recent years in the mediums employed in urography. The first medium suggested was a solution of colloidal silver termed "collargol." It was found, however, that the silver solutions were really not solutions, but suspensions, and that the undissolved silver particles acted as foreign bodies when injected into the kidney pelvis. Moreover, it was demonstrated that mediums injected into the renal pelvis frequently entered the tubules, the glomeruli, and the small capillaries. When the fine particles of silver became lodged in the tubules, they acted as foreign bodies and frequently caused infection. It is necessary therefore that mediums employed in urography should be true solutions and not suspensions. With this in view, Burns suggested a solution of thorium which overcame many of the objections to colloidal silver and still remains an admirable medium. Unfortunately, solutions of thorium occasionally have toxic effects and are difficult and expensive to prepare. Shortly afterward solutions of the iodids were suggested by Cameron, and later Weld used the bromids. These two mediums are now the most widely employed. The ease with which the bromids and iodids are prepared and their cheapness, together with the excellence of the shadows they cast, make them desirable. They may be slightly irritating to the mucous membrane, however, particularly if they are retained in the renal pelvis. In spite of the fact that these solutions are comparatively harmless, it is necessary to employ great care in the technique of their application. The medium should usually be introduced into the pelvis by the gravity method; it may be injected with a syringe only by an experienced urologist. Every precaution should be taken not to cause pain on injection. As a rule 5 c.c. of the medium will suffice and it is rarely necessary to employ more than 10 c.c. After the *x*-ray exposure is completed, it is advisable to remove the injected medium as completely as possible, particularly if there is evidence

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of ureteral obstruction. This may be accomplished by allowing the catheter to remain in the pelvis for some time and diluting with sterile water. Any medium, if allowed to remain in the renal pelvis, may be the cause of renal infection. It seems probable that this is the result of bacteria which in spite of every precaution are introduced by the medium. Bromid and iodid solutions, however, may cause irritation even without infection when retained in the pelvis, and considerable reaction in the renal tissue. In case the retained medium causes renal infection, it may be advisable either to consider an immediate nephrectomy or to insert a ureteral catheter into the pelvis and allow it to remain there. The formation of multiple cortical abscesses frequently noted in this condition is identical with septic nephritis and should be treated as such. Procrastination, in the hope that the acute process will subside, is of great danger to the patient, and it is seldom advisable to delay nephrectomy more than forty-eight to seventy-two hours after the first evidence of sepsis.

It is ten years since we began to employ urography in the diagnosis of disease conditions of the genito-urinary system, and it is appropriate that an inventory should be made of its practical value. The value of urography in selected cases of hydronephrosis, nephrolithiasis, pyelonephritis, neoplasm and anomaly is unquestioned. It should be remembered also that the demonstration of a normal pelvis may be of as much diagnostic value as the demonstration of one that is pathologic.

HYDRONEPHROSIS

A diagnosis of dilatation of the renal pelvis as the result of marked mechanical obstruction should usually be made without the employment of pyelography. The presence of residual urine in the renal pelvis can usually be determined if more than 15 c.c. of urine can be withdrawn with a syringe through a ureteral catheter or by the overdistention test; a pyelogram is then not necessary. If, however, the usual cystoscopic technique is insufficient to reveal the presence or absence of pelvic dilatation pyelography may be an important measure. This is particularly true in cases of moderate pelvic dilatation, and in cases of impassable obstruction to the renal catheter. The interpretation of the pyelogram in cases of hydronephrosis may be very difficult, due to (1) impassable obstruction at the ureteropelvic juncture, (2) dilution of the medium by retaining fluid, and (3) insufficient medium injected to outline the dilated pelvis. It may be difficult to distinguish between hydronephrosis and neoplasm when there is unfavorable obstruction at the ureteropelvic juncture. Occasionally dilution of the injected medium by urine retained in the pelvis will cause scattered areas which suggest neoplasm.

NEOPLASM

Pyelography is recognized as a frequent valuable aid in the diagnosis of neoplasm. When a pyelogram is followed by a marked reaction, as with hydronephrosis, an immediate nephrectomy is advisable since septic nephritis may complicate the neoplasm. Here again, the method should not be employed as a routine procedure, but only if the diagnosis is not possible without it. The differential diagnosis of epithelioma of the renal pelvis and tumor in the renal cortex may be difficult. A hydronephrosis, together with the deformity usually seen with neoplasm, suggests pelvic epithelioma. The greatest difficulty has been to distinguish between neoplasm and polycystic kidney. The character of the deformity may be identical in both conditions. As a rule, however, they are distinguished by the fact that a neoplasm is characterized by the retraction and narrowing of the calices, while polycystic kidney frequently has an abbreviation of one or more of the calices, and seldom any narrowing. It should be remembered, however, that when polycystic kidney is apparent from the clinical examination pyelography should not be employed. Not infrequently the medium

will not drain from the calices because of the obstruction caused by the dilated cysts, and cortical infection may ensue. Bilateral pyelography in cases of polycystic kidney is particularly contra-indicated.

NEPHROLITHIASIS

The purpose of a pyelogram in cases of nephrolithiasis is to identify and localize the shadow. As a methof of identification it is of considerable value, particularly in the differentiation of shadows on the right side which may easily be confused with gallstones. However, since the introduction of fluoroscopy at the time of operation localization of the stone is not of great value. Identification of shadows in the ureter by means of ureterography still remains the best method. The relation of a leaded catheter inserted in the ureter to a shadow in the ureteral area is too indefinite to be of accurate diagnostic value when the catheter is less than 1 cm. distant.

ANOMALY

Demonstration of pathologic complications together with anomaly of the kidney and ureter by means of urography is a valuable aid in their diagnosis. It must be remembered, however, that retention of a medium in a single kidney may offer serious complications. The demonstration of an anomalous position of a kidney, or of a fused kidney, can frequently be accomplished simply by the introduction of a lead catheter.

Distinguishing simple inflammatory dilatation from dilatation of renal tuberculosis is occasionally of importance. The extent of renal destruction as a result of chronic infection may often be appraised only by the demonstration in the pyelogram of marked inflammatory dilatation and cortical necrosis.

CYSTOGRAPHY

The clinical value of demonstrating the outline of the bladder, which is termed cystography, as an aid to diagnosis, is not fully appreciated. It may be of considerable diagnostic aid in the presence of vesical neoplasm, vesical diverticulum, and prostatic obstruction, particularly when a complete cystoscopic examination is impossible, because of excessive hematuria, intolerance, contraction of the vesical lumen, or impassable urethral obstruction. The existence of a vesical tumor may be inferred from the presence of a filling defect in the outline of the bladder. The extent and character of the filling defect may also determine the size and nature of the tumor. It must be remembered, however, that partial distention of the bladder, reflex spasm, presence of blood clots, and so forth, may cause error in interpretation.

Diverticulum.—The opening of a diverticulum of the bladder is very easily overlooked on cystoscopic examination, and the diagnosis may be possible only by means of a cystogram. In fact, even though the opening of a diverticulum is visible on cystoscopic examination, a cystogram is advisable because of the possibility of the presence of multiple diverticula. Since a cystogram taken at one angle may easily overlook the presence of a diverticulum, it is always advisable to make an exposure in the anteroposterior position, and at the right and left angles. This will render visible the outline of the diverticulum, which might otherwise be obscured by the overlying bladder. Further it is advisable to have the patient empty the bladder as completely as possible, and repeat the cystogram. A lead catheter coiled in the diverticulum is sometimes of value in determining its size. Diverticula of the urethra and urethrocele may also be determined by this method.

Prostatic Obstruction.—Occasionally for technical reasons it may be difficult to make a cystoscopic examination in the presence of prostatic obstruction. A large prostatic gland, particularly with median intravesical projection, will cause a filling defect of the bladder outline at the urethral opening. Occasionally, however, such an evident filling

defect may be caused by gas in the bowel, and failure to distend the bladder, and prostatic obstruction may be erroneously inferred.

CYSTO-URETEROGRAM

A cysto-ureterogram may be of some value in certain cases, particularly if there is marked inflammatory dilatation of the renal pelvis and ureter, and if the cystoscopic examination is unsatisfactory. The cysto-ureterogram is made after the bladder is filled with an opaque medium while the patient is in extreme Trendelenburg position. If the lower ureter and meatus are patent the medium will gravitate into the dilated ureter and occasionally into the renal pelvis. The method, however, is not without danger if the medium enters both renal pelves and is then unable to drain readily.

In conclusion, it may be said that urography is one of the most valuable aids we have in the diagnosis of lesions involving the urinary tract. Its limited application, and the difficult and dangerous technique unless carefully safeguarded, will restrict its use, but the method merits a wider employment, and, I believe, in the future will receive it.

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ROENTGENOLOGY IN DISEASES OF THE TEETH*

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A FULL mouth roentgenogram is one of the important points in the examination of teeth. In the past we have been content to ray suspicious teeth only, but we now see the value of raying not only the teeth that can be observed clinically, but the spaces from which teeth have been removed without regard to the time that has elapsed since the extraction. In this manner it is possible to demonstrate that we have been overlooking pathologic conditions that may have existed for years in these spaces under artificial plates.

The full mouth roentgenogram makes it possible to distinguish the normal condition, and thus a comparison may be made in order to diagnose the abnormal, while a single film may leave us very much in doubt.

So far as the *x*-ray is concerned a rarefied area means only a loss of bone; therefore, in the extraction of teeth no distinction should be made between the large and small areas. Time is an important factor in the interpretation of dental films; it has been the experience in the Clinic that many teeth which show only slight evidence of infection in the roentgenogram have proved to be harborers of infection on laboratory experimentation and from the relief to the patient following removal.

It is also important to have the patient present when the full mouth films are diagnosed. It is obvious that a more complete diagnosis may be given if the clinical findings are checked with the *x*-ray evidence. In other words, it is important to put the ex-

*Read at the Twenty-first Annual Meeting of The American Roentgen Ray Society, Rochester, Minn., Sept. 14, 1920.

ploring instrument on the tooth to be sacrificed.

Another point of value is that the dental roentgenologist should observe the extraction of teeth that show definite pathologic conditions. With the so-called surgical removal of teeth it is possible to demonstrate conditions that were overlooked with the old technique of pulling the tooth.

It is just as necessary for the dental roentgenologist to observe end results in order to become efficient as a diagnostician as it is for the roentgenologist in gastro-intestinal work. Reports of dental examinations by the physician or the dentist cannot have much weight unless the end results are visualized at the time the dental films or plates are examined.

The medical profession is still somewhat opposed to the extraction of infected teeth, because the results have not always been satisfactory. In answer to their just criticism it may be stated that by the newer technique of removing teeth (surgical removal) the tooth with the pathologic condition is removed with the minimum of trauma and without injury to adjoining teeth. By this method the maximum of regeneration of bone is obtained by allowing the muco-periosteum to fall into the socket. It is as important to remove all the infected conditions about the tooth as to remove all of the tonsils.

OSTEOCARTILAGINOUS JOINT BODIES*

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THE subject of loose osteocartilaginous joint bodies appeals, I believe, to the roentgenologist as well as to the surgeon, and this is my excuse for presenting the subject briefly to you.

We have found loose osteocartilaginous bodies in the knee, the elbow, and the shoulder, the frequency of occurrence being in the order given.

In the knee these bodies seem to be formed in several different ways. Some persons have a peculiar condition, designated as a clinical entity, called osteochondritis dissecans. Koenig, years ago, described it and thought it due to a blocking of the end artery supplying an area in the internal condyle just back of the insertion of the posterior crucial ligament. He could give no explanation of why this artery became plugged. It is possible that the stress put on the posterior crucial ligament has something to do with the formation of loose bodies from this area. It is not uncommon to find both knees affected. The loose bodies are not numerous in osteochrondritis dissecans, rarely more than two or three. The symptoms are recurrent catching or locking, but they are less violent than when the derangement is caused by one of the semilunar cartilages, and often the patient can feel the body or bodies in different situations. Roentgenograms show the body or bodies, likewise a depression, particularly in the anteroposterior view, on the internal condyle near the insertion of the posterior crucial ligament (Fig. 1). The patients in this group are usually under forty years of age.

In certain persons portions or pieces of the marginal osteophytic growths due to hypertrophic arthritis may be broken off and wander about the joint, and, nourished by the joint fluid, increase in size (Fig. 2). There may be six or seven quite large and rough bodies. Roentgenograms show marked hypertrophic arthritis. The symptoms are similar to those in osteochondritis dissecans with the exception that the arthritis causes

more stiffness and soreness between the spells of locking. The patients in this group are usually more than forty years of age.

Occasionally a patient presents himself with a knee filled with osteocartilaginous loose bodies. On palpation the knee feels like a sac filled with marbles. The roentgenograms show the bodies, perhaps fifteen, twenty, thirty or more, but the joint surfaces look smooth. This condition is called osteochondromatosis (Fig. 3). The bodies are formed by the somewhat thickened synovial membrane, hanging in folds and teats of tissue, the latter at first fibrous, later becoming cartilaginous bulbs. As these cartilaginous bulbs increase in size, they are detached by their weight and become wandering joint bodies; they also, nourished by the synovial fluid, continue to increase in size. Strange to say, with removal of the bodies a cessation of the process seems to occur. In the embryo the joint surfaces and the synovial membrane are developed from the same layer of mesial blastema and it is probable that the condition is brought about by some incomprehensible reversion or perversion of tissue. In one of our cases the condition was associated with a tumor in the lower end of the femur which on exploration was pronounced chondroma. The tumor recurred; it then proved to be more cellular and was pronounced chondrosarcoma. Amputation was done but the patient died in less than a year with multiple metastasis in the lungs. We might well consider osteochondromatosis to be a benign neoplasm.

The elbow is not infrequently the site of loose bodies. Usually a history of trauma sustained many years before may be elicited. The symptoms are milder than when the bodies occur in the lower extremities. Invariably there is loss of extension with occasional locking or catching. The roentgenogram may show only two or three bodies, or it may show twenty, thirty, or more (Fig. 4). As in the knee, some of the bodies may be due to hypertrophic arthritis, but so far as I know there is no condition analagous to the osteochondritis dissecans found in the knee. I have seen a number of patients, however, who at operation on the elbow presented the typical picture of osteochondromatosis. The fact that the symptoms produced by loose bodies in the elbow are less disabling than a similar condition in the knee is probably the reason that more cases are not observed. If

Fig. 1. Case 142135. Osteochondritis Dissecans. Two loose bodies in the intercondylar notch which arose from the area marked in the internal condyle.

Fig. 2. Case 108373. Hypertrophic Arthritis of Twenty Years' Duration. Loose body in the suprapatellar pouch.

more roentgenograms were taken of elbows showing limitation of extension, I believe we should be astonished at the number in which loose bodies would be found.

FIG. 3. CASE 157963. LOOSE OSTEOCARTILAGINOUS BODIES IN THE KNEE DUE TO OSTEOCHONDROMATOSIS.

We have observed loose bodies in the shoulder joint in one patient only (Fig. 5). This patient was a well developed young woman of twenty who for eight years had suffered from irregular spells of pain in the shoulder gradually increasing in severity and frequency. The pain was undoubtedly produced by the catching of the bodies between the joint surfaces. Stiffness and soreness followed attacks. Ten good sized bodies were removed through a posterior incision and a roentgenogram taken afterward showed the joint to be free. About one year later there was a recurrence of symptoms and a roentgenogram showed shadows which I believe may be of reforming bodies. A mild hypertrophic arthritis in the joint did not appear sufficient to be responsible for the formation of the bodies. So far as I could ascertain, there was no evidence of osteochondromatosis or other abnormality, and I was, therefore, at a loss satisfactorily to account for the condition.

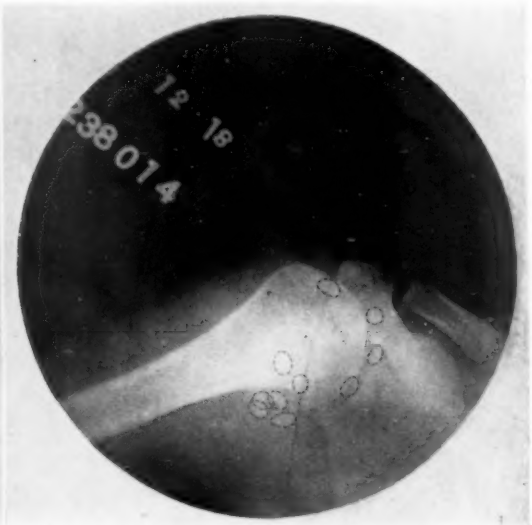

FIG. 5. CASE 238014. LOOSE OSTEOCARTILAGINOUS BODIES IN THE SHOULDER JOINT.

FIG. 4. CASE 126099. LOOSE OSTEOCARTILAGINOUS BODIES IN THE ELBOW JOINT.

Occasionally in patients suffering with tabes dorsalis loose particles occur in Charcot joints, but they are not free bodies and I have not seen mechanical derangement produced by them. I did not, therefore, consider them in this discussion.

CHRONIC GASTRIC ULCER AND GASTRIC CARCINOMA*

A STUDY OF 507 SIMPLE CHRONIC ULCERS AND 895 CARCINOMATOUS ULCERS**

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IN spite of the fact that many articles have been written, and much discussion has occurred, there are the three following questions still asked by members of the medical profession: 1. Does carcinoma develop on chronic gastric ulcers? 2. What percentage of chronic gastric ulcers become carcinomatous? 3. Does carcinoma develop in the base or border of a chronic gastric ulcer? These are asked so frequently that it seems in order to restate the facts which have been observed repeatedly in the study of a large series of fresh resected or excised gastric specimens. The facts have been stated before; and they have been illustrated by photographs of gross and microscopic specimens. The facts should be reduced to principles which may be plainly stated and diagrammatically illustrated.

1. Ulcers of the stomach may be divided into two great groups, acute ulcers and chronic ulcers.

2. Chronic ulcers of the stomach may be divided into two great groups, simple gastric ulcers and carcinomatous ulcers.

3. Simple and carcinomatous chronic gastric ulcers occur as single or multiple lesions (Fig. 1), large or small, shallow or deep lesions (Fig. 2), in any portion of the stomach, but they usually occur near the pylorus (Fig. 3) in the lesser curvature or posterior wall, although they do appear rarely in the anterior wall and greater curvature (Fig. 4).

4. There are two portions of gastric ulcers of interest and importance to pathologists, clinicians, surgeons and patients. These are the borders and the base of the crater (Fig. 5).

5. The base of the crater of a simple or carcinomatous ulcer may involve one or more coats (Fig. 6).

6. Chronic ulcers, associated with carcinoma, always involve the mucosa and usually one or more of the other coats.

7. One finds chronic gastric ulcers in

**

	Carcinomatous Ulcers	*Simple Chronic Ulcers*
1904	1	
1905	36	4
1906	29	10
1907	27	8
1908	42	13
1909	45	13
1910	47	21
1911	45	17
1912	45	32
1913	59	37
1914	68	39
1915	70	40
1916	49	39
1917	84	60
1918	62	61
1919	105	52
1920 (to Oct. 1)	84	61
	895 Total	507 Total

*Read at the Twenty-first Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Rochester, Minn., Sept. 14, 1920.

which there are no microscopic or macroscopic signs of carcinoma; the lining epithelial cells of the gastric tubules are "columnar" and practically equal in size, their long axes being parallel; the nuclei are ovoidal and of about the same size, being about one third the volume of the whole cell (Fig. 7, A); the tubules may be found distorted; there is usually a lymphocytic infiltration of one or more coats; there is always necrosis of the tissue in the base of the crater regardless of the coat involved; the general trend of the scar tissue is perpendicular to the surface of the crater.

8. One finds chronic gastric ulcers which answer the exact macroscopic and microscopic description of simple chronic gastric ulcers plus one visible difference, that is, the replacement of some or all of the "columnar" epithelial cells of the gastric tubules by ovoidal or spheroidal cells, the nuclei of which are about one half the volume of the cell and contain one or more definite and distinct spheroidal nucleoli; these replacing cells vary somewhat in size and their long axes are not parallel; the cells themselves, are morphologically indistinguishable from cells which are definitely known to be carcinomatous; the replacing cells in this group of ulcers are intratubular (Fig. 7, B.).

9. One finds chronic gastric ulcers which answer the macroscopic and microscopic description of chronic ulcers, just described, plus the presence of the spheroidal or ovoidal cells in the stroma (Fig. 7, C). They are sometimes only in the mucosa.

10. In all cases which have been studied, if the undifferentiated or partially differentiated ovoidal or spheroidal cells are found in coats other than the mucosa they are always found in the mucosa. The reverse of this is not true. Whenever these cells are found in the base of an ulcer they are always present in the mucosa. The reverse of this is not true. When the cells are found only in the mucosa and sometimes in the mucosa, submucosa, muscularis and subserosa the

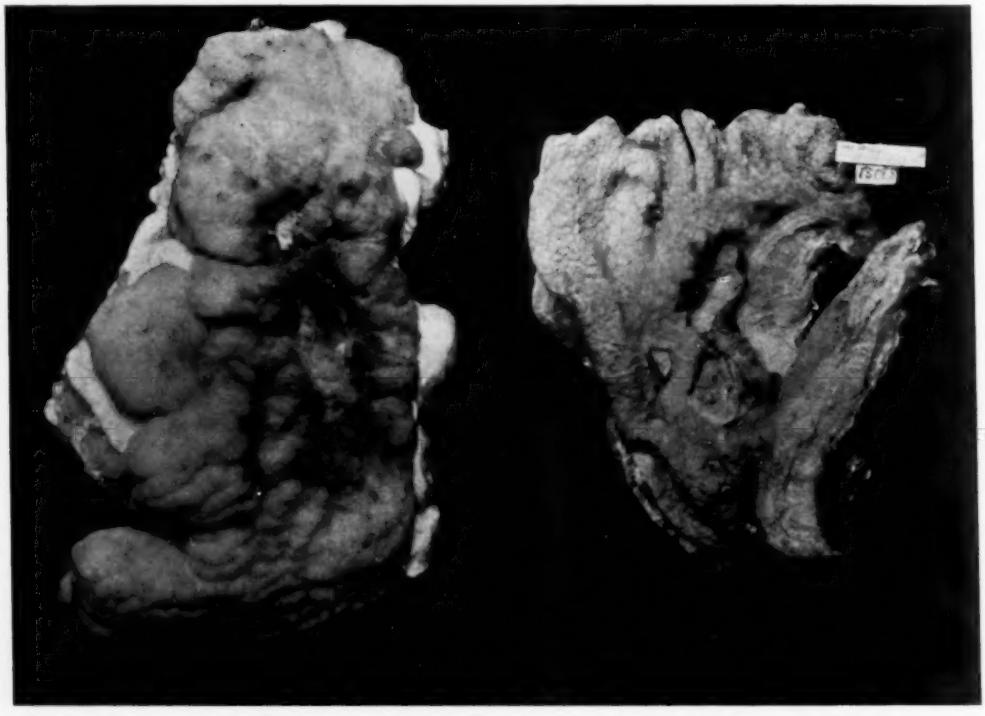

FIG. 1. PHOTOGRAPHS OF PORTIONS OF TWO STOMACHS, showing multiple chronic gastric ulcers.

gross appearance of the ulcer is not always altered.

11. Chronic gastric ulcers larger than 2 cm. in diameter are usually but not always carcinomatous.

These being facts which can be confirmed by any large series of specimens studied carefully, there are certain practical deductions which may be logically and hence scientifically drawn.

1. If the surgical pathologist cannot distinguish always grossly simple chronic gastric ulcers from carcinomatous gastric ulcers, it is impossible for surgeons, roentgenologists and clinicians to make the differentiation with their lesser instruments of observation, there being no specific clinical or laboratory test for early cancer.

2. Every patient harboring a chronic gastric ulcer has the possibility of also harboring a carcinomatous gastric ulcer, and the differentiation must of necessity be made by the surgical cyto-pathologist, early cancer being a microscopic lesion. In a series of 475 gastric cancers studied, 52.6 per cent were diagnosed clinically positively, 22.7 per cent were diagnosed clinically carcinoma with a question mark, 3.1 per cent were diagnosed clinically "tumor," 2.7 per cent were diagnosed clinically "pyloric obstruction," 8 per cent were diagnosed clinically gastric ulcer with a question mark, and 3.1 per cent were diagnosed clinically "explore." The remaining 7.8 per cent were diagnosed clinically duodenal ulcer, appendicitis, or cholecystitis with or without stones. These figures are presented merely to show just what percentage of times the correct differentiation can be made clinically; they do not represent the clinical efficiency in so far as the welfare of the patient is concerned, because the clinicians who made the pre-operative diagnoses always gave pre-operative instructions, in all cases making possible the positive determination of what condition was present at operation. All patients had the benefit of physical examination, laboratory tests, *x*-ray examinations, surgical exploration, and immediate microscopic examination during operation. The figures merely prove the logic; that is, if the pathologist with the specimen in his hand cannot make the gross differentiation of the simple chronic ulcers and carcinomatous ulcers in a large percentage of specimens, such differentiation should not be expected of the clinician, surgeon and roentgenologist.

3. The surgeon and pathologist can always make a very fair macroscopic guess as to the nature of the ulcer from its size by virtue of the fact that most chronic gastric ulcers larger than 2 cm. in diameter are carcinomatous. The converse of this is not true, because many chronic gastric ulcers, smaller than 2 cm. in diameter, are carcinomatous.

4. The roentgenologist, who, by fluoroscopic or other means, can determine the diameter of an ulcer, even approximately, may also guess that a lesion larger than 2 cm. in diameter is carcinomatous.

The facts herewith presented are also of value in answering the three questions in the introduction. The first, "Does carcinoma develop on chronic gastric ulcer," cannot be answered because there are no positive or negative facts regarding development visible in the study of simple or carcinomatous gastric ulcers. No one has experimentally produced a chronic gastric ulcer and then produced a carcinoma in that experimental ulcer. The second, "What percentage of gastric ulcers become carcinomatous," cannot be answered by virtue of the fact that it cannot be shown positively that carcinoma develops in an ulcer. The third, "Does carcinoma develop in the base or border of chronic gastric ulcers," cannot be answered for the same reason that the second question cannot be answered. The fact that these questions cannot be answered does not decrease our efficiency in dealing with chronic gastric and carcinomatous gastric ulcers. The great and important practical questions are: 1. Is gastric carcinoma associated with chronic gastric ulcer? Answer—Yes. 2. Is the association of the two conditions sufficiently frequent to be of importance? An-

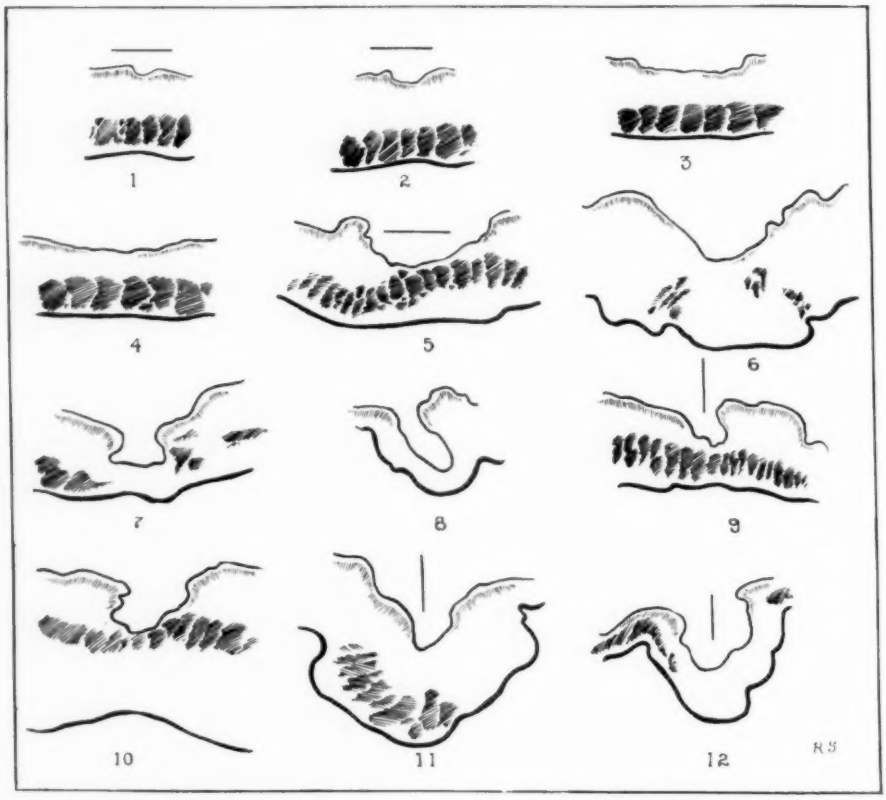

FIG. 2. DIAGRAM MADE FROM DRAWINGS OF GROSS SECTIONS OF SPECIMENS SHOWING VARIOUS SHAPED CRATERS OF CHRONIC GASTRIC ULCERS. The drawings are made to the same scale and the straight lines represent one centimeter. The mucosa and muscularis are shown by shading.

swer—Yes. 3. Can we state always clinically positively whether a gastric ulcer is or is not carcinomatous? Answer—No. 4. At exploration can we always state grossly whether a gastric ulcer is or is not carcinomatous. Answer—No. 5. Without the power of always grossly differentiating simple chronic gastric ulcer from carcinomatous ulcer, and positively knowing that a chronic gastric ulcer actually exists, what positive logical practical advice can be given? Answer—Consider the possibility of a chronic gastric ulcer being carcinomatous; excise or resect the ulcer and submit the specimen to a well trained surgical cyto-pathologist. 6. In view of the facts regarding the frequent association of carcinoma with chronic gastric ulcer, and our inability always grossly to differentiate the two conditions, what would we want to have done therapeutically if we possessed the ulcer, especially in view of the fact that extensive removal of a malignant neoplasm such as carcinoma has been demonstrated repeatedly to be the only known posi-

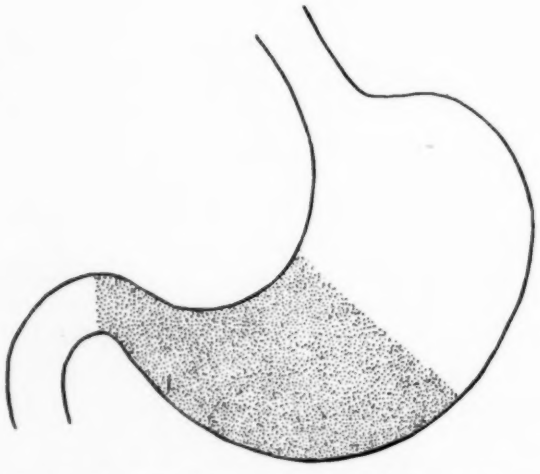

FIG. 3. DIAGRAM OF THE STOMACH showing the area (shaded) in which simple and carcinomatous gastric ulcers usually occur.

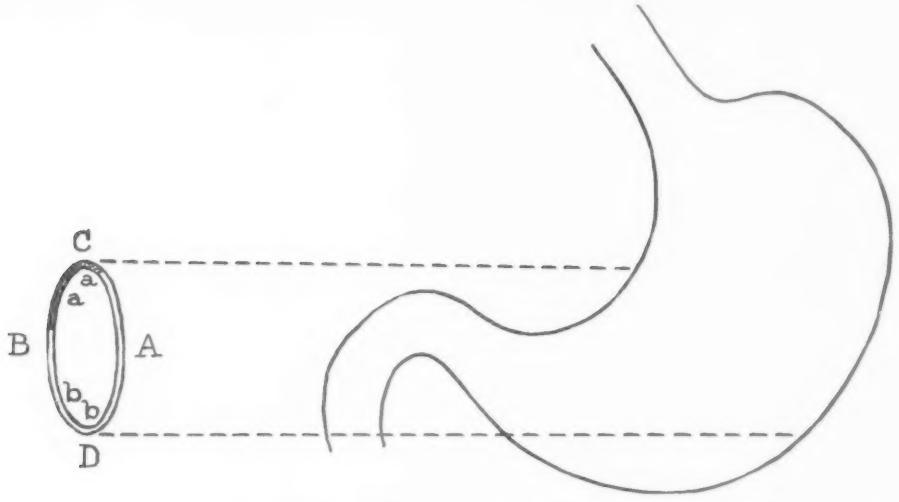

FIG. 4. DIAGRAM OF THE STOMACH SHOWING A PROJECTED SECTION OF THE ORGAN. A, anterior surface; B, posterior surface; C, lesser curvature; D, greater curvature; a, the most frequent location of chronic gastric ulcers (simple and carcinomatous); b, occasional location of chronic gastric ulcers (simple and carcinomatous).

tive means of combating the advance of such a devastating growth? Answer—Most of us would want our ulcer widely resected if possible. 7. What have been the results of resection of carcinomatous chronic gastric ulcers? Answer—Some of them, even with extensive glandular involvement, have lived nine and ten years after the resection. 8. Do we know which cases will live nine or ten years? Answer—No; but in our experience patients presenting specimens showing a combination of partial differentiation of the cancer cells plus extensive lymphocytic infiltration, have lived 148 per cent longer than those without partial differentiation and extensive lymphocytic infiltration. There are, however, so many factors connected with resistance to cancer that, with our present knowledge, we cannot always accurately prognosticate.

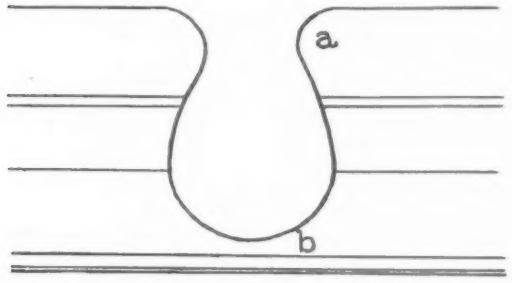

FIG. 5. DIAGRAM SHOWING THE TWO POINTS WHICH HAVE BEEN CLAIMED FOR THE STARTING POINTS OF CANCER OF THE STOMACH. a, the border, the latter being the point in which the earliest changes have been found in my experience; b, the base of the ulcer.

While the whole problem of cancer is far from having been settled, there are some things concerning the relation of chronic

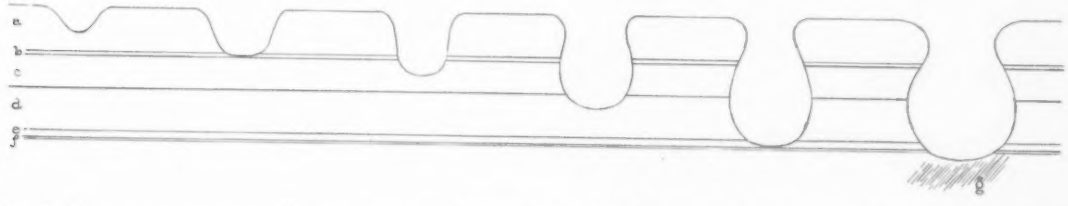

FIG. 6. DIAGRAMS SHOWING EXTENSIONS OF ULCERS INTO THE VARIOUS LAYERS OR COATS OF THE STOMACH. a, mucosa; b, muscularis mucosae; c, submucosa; d, muscularis; e, subserosa; g, some neighboring structure involved in the base of an ulcer.

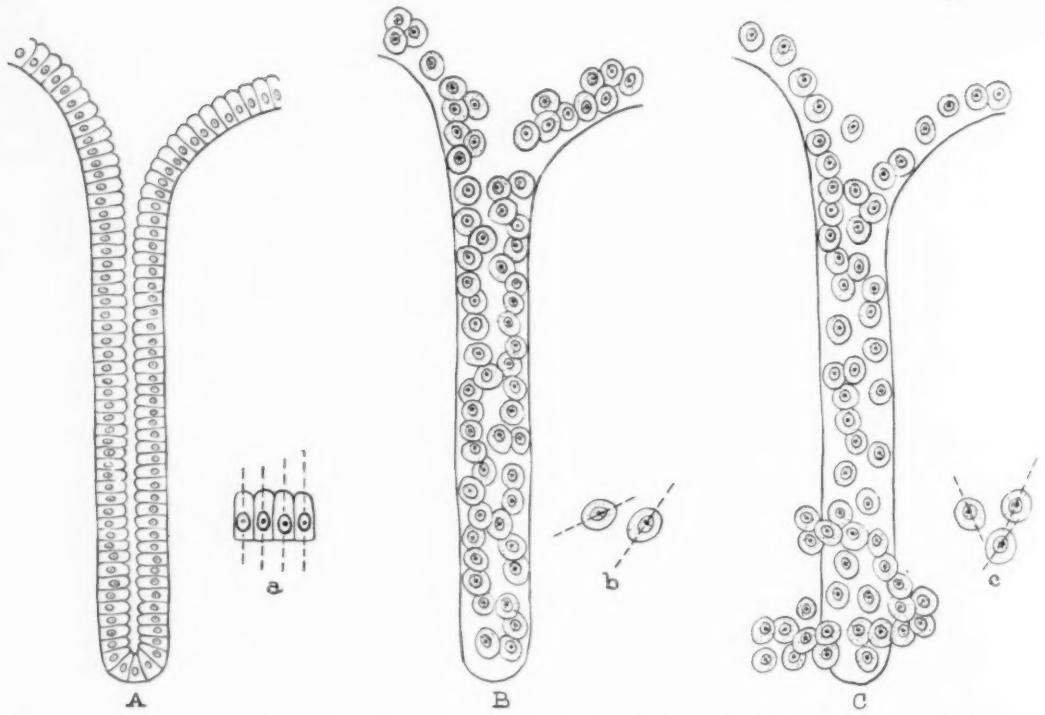

FIG. 7. DIAGRAMS OF THE CYTOLOGICAL PICTURES FOUND IN THE MUCOSA OF CHRONIC GASTRIC ULCERS. A, the normal gastric tubule with columnar epithelium, the long axes of which are parallel. a, the individual cells lining a normal gastric tubule; the nuclei of the cells are about one-third the volume of the whole cell. B, a gastric tubule found in the mucosa of some chronic gastric ulcers; the columnar cells are replaced by ovoidal or spheroidal cells containing nucleoli; the long axes of the cells are not parallel; the nuclei are about one-half the volume of the cells (a); C, a gastric tubule sometimes found in the mucosa of chronic gastric ulcer; the cells are similar if not identical with the cells in tubule B but they are also found in the stroma.

gastric ulcer and gastric carcinoma which are known and these I have attempted to state systematically, clearly and briefly. These have been frequently shown to be facts and may be confirmed by other large series of specimens.

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PRE-OPERATIVE AND POSTOPERATIVE X-RAY IN CARCINOMA OF THE BREAST*

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IN the treatment of cancer of the breast the profession is now divided into three main groups: (a) Those confining their efforts to surgery alone; (b) those resorting to surgery first and following the radical operation with *x*-ray treatment, and (c) a small but increasing number who use *x*-ray treatment as a preliminary procedure followed by a complete surgical removal of the breast and then thorough postoperative radiation.

It is in the hope of enlarging the latter group that this paper is presented.

During the last half century the improvements in surgical technique, in diagnosis, and in the selection of cases has done a great deal to advance the treatment of mammary cancer. The statistics of the surgical treatment alone are, however, far from reassuring; and since the surgical operation for removal of the breast has reached a high state of technical perfection, it leaves much to be hoped for from other agents.

That this hope has been partially realized is evident from the voluminous reports in the more recent literature. Comparatively few of the more recent workers have quoted definite statistics, probably because of lack of sufficient time. Boggs [2] states that recurrences may be prevented in 25 to 50 per cent of cases by proper postoperative radiation. Pfahler [3a] believes that the end results can be improved at least 25 per cent by "thorough, competent, postoperative *x*-ray treatment." Todd [4] in 1916 reported that for the previous three years he had been using *x*-ray as a postoperative measure and that during that period he had not lost a patient nor had he had a recurrence. Deaver [3a] has reckoned the prognosis at 25 per cent better when postoperative radiation is used. In addition to these there are many other reports endorsing the value of *x*-ray as a postoperative measure of importance.

Other workers, recognizing the benefits thus far conferred, attempted to add to the efficiency of the *x*-ray treatment by exposures into the open wound at the time of the surgical operation, the immediate object being the control of implantation metastases. Here, as in other fields of roentgen therapy, Pfahler [3b] was one of the pioneers, and speaks highly of the method from both a theoretical and a practical standpoint. He credits Dr. Foerster of Milwaukee with being the first to use the method. Morton,[5] as far back as 1911, advocated the same method, and Holding [6] did a great deal of work along the same line, with excellent results.

The striking effect of *x*-ray on the generative organs has been made use of to simulate in part the older surgical procedure of castration as an aid in controlling the recurrences and metastases of mammary cancer in women not yet past the menopause. Knox [7] favors this procedure and states that it is done at the Freibourg Clinic. Pfahler [5c] quotes Theilhaber as advocating it, but states that while he considers it worthy of a trial, he has had no experience from the technique. The writer feels called upon to say that he has seen no good from either castration or the production of a premature menopause by *x*-ray, and that any apparent benefit derived from the latter treatment is, in his opinion, due to the control of lower abdominal metastases from direct radiation rather than to any indirect effect produced through the ovaries.

It will at once be noted that all measures previously mentioned interfere in no way with the surgical procedure. The precedent against immediate surgical intervention,

*Thesis presented with application for membership in THE AMERICAN ROENTGEN RAY SOCIETY, 1920.

once a clinical diagnosis of mammary cancer has been made, has not been questioned or interfered with.

In view of the surgical statistics of results of operation alone, and in the face of the voluminous reports of benefit conferred by *x*-ray in the inoperable and recurrent cases, as well as in the postoperative cases, is it necessary or wise to observe this surgical precedent further, provided added safeguards by some preoperative treatment can be established?

That *x*-ray stands first in offering this added safeguard also is quite evident from thell and Barclay [9] have treated some primary cases for three or four years with *x*-ray alone, keeping them in check and apparently preventing metastases. This latter observation relative to the apparent prevention of metastases is as important as the direct destructive effect on the malignant cell, if not more so. It may be due in part to this destructive effect, but not entirely. The *x*-rays exert a very marked effect on he endothelial cells forming the walls of the lymphatics, and in that way tend to block the main channels of dissemination through atrophy. Pre-operative radiation offers still

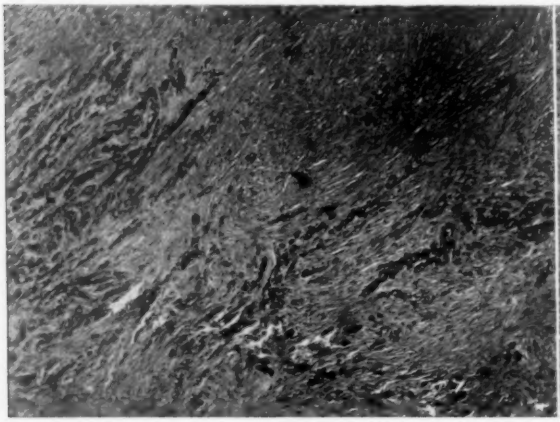

FIG. 1. x60: BREAST REMOVED 16 DAYS AFTER COMPLETING *x*-RAY CYCLE.

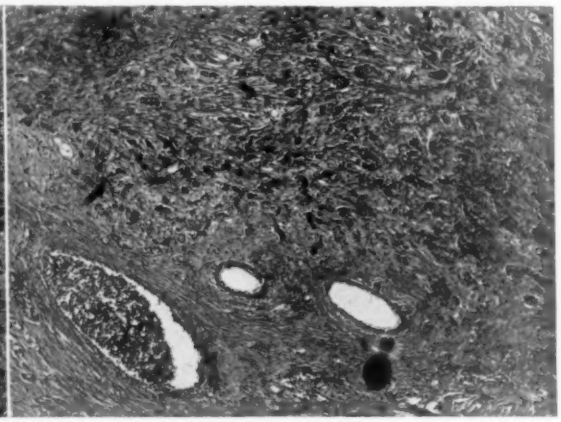

FIG. 2. x60: BREAST REMOVED 28 DAYS AFTER COMPLETING *x*-RAY CYCLE.

our mass of knowledge of its action. As Pfahler [3d] has expressed it in discussing the value of *x*-ray in inoperable cancer of the breast, it "offers considerable hope of a cure in some cases, relief from pain and discharge in others, prolongation of life in many and some benefit in practically all." Von Angerer [6] has noted that the rays inhibit the growth of the tumor cells and has demonstrated that they can cause involuntary changes in the tumors or transform them into less malignant ones. Handley [3e] found that a radiant treatment of two or three weeks' duration had a direct selective effect on the cancer tissue, consisting of a primary injury to the cancer cells which led to a disturbance in growth, lack of mitosis, giant-cell formation, and, to a certain degree, to changes in the character of the cells. Bymore; by taking advantage of it some inoperable cases are rendered operable. Newcomet [10] has mentioned several permanent cures of this type, and Holding [6] has reported similar instances.

In our own series of cases one may be cited as an example. A woman thirty-nine years of age had noted a nodule in the lower inner quadrant of the left breast for four years. Following the birth of a child, fourteen months previous to her admission to the hospital, this mass began to enlarge and the skin over it became red and fixed. At the time of admission the mass, which measured 2½ cm. in diameter, was firmly fixed to the ribs and intercostal muscles beneath it, while the skin over it was reddened, fixed and retracted. A chain of glands up to 1½ cm. in diameter was palpable beneath the

pectoral fold up to the apex of the axilla. One definite supraclavicular gland was palpable near the inner end of the clavicle. Radiographic examination of the chest was negative and on the right side there was no palpable evidence of disease. This patient was given one complete cycle of massive *x*-ray therapy delivered at cross-fire through multiple portals of entry over the breast and all regional glandular areas. This required four days. During the next four weeks the primary mass became smaller and movable; the sub-pectoral and axillary glands decreased in size, and the supraclavicular gland disappeared entirely. At the end of this time a complete breast amputation, with removal of the axillary lymphatics, was done. As soon as the patient was able to be out of bed another cycle of treatment was begun and has been repeated four times since. It is now nearly two years and the patient presents no visible or palpable evidence of disease. Microscopic examination showed a malignant type of fibro-carcinoma, the cells of which indicated marked degenerative changes.

The favorable effects of *x*-ray on recurrent and metastatic skin nodules of mammary cancer, carcinoma "en cuirasse," and Paget's disease of the nipple, noted by Knox,[7] Archibald,[11] Pfahler,[3f] Ochsner and Percy,[12] Newcomet,[10] and many others, suggests an added reason for preoperative radiation. A study of the superficial lymphatic drainage of the breast very strongly suggests that many of the regional skin recurrences, commonly considered implantation metastases, are really direct extensions to the skin through the elaborate channels of this superficial lymphatic plexus. The treatment into the open wound was advanced primarily to care for these metastases, but it at once becomes apparent that they can be better handled before operation. The exposures can be made much more accurately, a wider surface can be covered, wound infection is obviated and not only is the destructive effect on malignant cells produced, but atrophy and partial obliteration of the lymphatic channels is brought about prior to operation. Another factor of importance must not be disregarded, in being able to dispense with this treatment at the time of operation —to be of value it cannot be carried out in less than 15 or 20 minutes, and the patient meanwhile remains under the influence of anesthesia awaiting the final steps of the surgical operation. That this is a detriment to the patient was shown in 1916 by Gaylord,[1a] who proved experimentally that prolonged anesthesia and hemorrhage reduces the resistance to cancer.

Influenced by these considerations, we were led to adopt the preoperative *x*-ray treatment of carcinoma of the breast at the Memorial Hospital between two and three years ago.

Each case of primary breast cancer is referred to the *x*-ray department for a complete cycle of treatment, and decision as to subsequent surgical intervention in doubtful or border-line cases reserved for a period of two to four weeks. Before treatment is begun, a careful radiographic examination of the chest is made to determine, as far as possible, the status of the pleura and mediastinum. The cycle of treatment follows a routine plan up to a certain point and is then varied to meet the peculiar needs of the individual case. In all cases the involved breast, pectoral, axillary, infraclavicular and supraclavicular regions on the same side are treated, as a routine. When the growth presents clinical evidence of being more malignant, a wider field is covered to take in the epigastric region, a wide skin area around the breast, the inner half or all of the opposite breast, and the opposite axilla and supraclavicular region. The numerous paths of lymphatic extension immediately beneath the skin call for a wide zone of skin radiation, especially in case of carcinoma *"en cuirasse,"* in all bulby growths, and in those with retraction of skin. Ewing,[1b] has noted that in a certain percentage of cases there is a direct lymphatic connection with the opposite axillary nodes. Tumors of the inner segment of the breast are most favorably located for this, and in all of these the opposite axilla should receive particular at-

tention. Mandley's[1e] finding of approximately 12 per cent of cases at autopsy, showing abdominal involvement without chest invasion, indicates the need for radiation over the epigastric region. As stated before, the axillary trunks should always be radiated, because they are the main paths of dissemination; and since there are such free anastomoses between these and the subpectoral, infraclavicular and supraclavicular groups, radiation of one group should always be accompanied by exposures over all.

Once the areas to be treated have been determined, the skin over all available portals of entry is marked off into areas approximately 2½ to 3 inches square. In doing this it must be borne in mind that certain parts can be reached from more than one angle. Thus the breast itself can be radiated over its surface and from the side, the axilla can be reached both from before and behind as well as directly, and the same applies to the supraclavicular space. This radiation at cross-fire furnishes the most valuable feature of the treatment, because the absorption of radiation in the deeper parts, in its greatest intensity, is the object sought. The skin over each area treated receives its tolerance of radiation from the one direct dose; but this is not the case, of course, in the deeper tissues. Boggs[2] has shown that with an 8-inch skin-target distance the tissues 4 inches beneath the skin receive about one-seventh as much radiation as the skin. It is thus extremely important to utilize as much cross-firing of rays as possible.

Each area mapped out as indicated receives a massive dose of *x*-rays, in other words, as much as the skin will tolerate without superficial destruction. Our fixed factors in giving these exposures have been an 8-inch skin-target distance, 9½ inch parallel spark-gap back-up, 7 milliamperes of current through the tube, and usually 4 millimeters of aluminum filter. In some instances, where deeper penetration was desired, especially about the axilla, in an effort to obtain this, the filtration was increased to 6 mm. of aluminum. The equipment has been a high tension interrupterless transformer and Coolidge tube, throughout.

Treatments are given daily in an effort to cover the period as rapidly as possible. The number of exposures given each day varies, depending on the way in which the patient tolerates the treatment; usually two to four areas may be radiated at one sitting without an undue amount of nausea and depression. The immediate unpleasant symptoms incident to treatment are never severe enough to be classed as contra-indications to the procedure. To date, we have reached no definite conclusions as to the cause of this nausea of radiation. The mental factor plays a part, undoubtedly, but does not account for all of it. Our observations on the CO_2 content of the blood before and after treatment have given little information of value. Certainly the generation of gases about the transformer has little to do with it, else why should the operators and attendants be free from such symptoms at all time.

After the cycle of treatment is completed in this manner, the patient is placed under the observation of the surgeon and roentgen therapeutist. The cases belonging to the strictly operable class are operated upon two weeks after the *x*-ray cycle has been completed. Those more advanced are continued in the *x*-ray department and given another cycle of treatment at an interval of four weeks. After one or two cycles of treatment, a certain percentage of cases, inoperable at first, receive sufficient improvement to place them in the operable group.

Since the operation is not done until two weeks after the last *x*-ray treatment, it is at once apparent that the skin is ready for a cycle of postoperative *x*-ray immediately the patient is able to be out of bed following the radical operation. The cycle is carried out in exactly the same manner as the former cycle of preoperative radiation.

This procedure permits of doing the surgical removal of the breast in the interval between two cycles of *x*-ray treatment. It has no adverse influence on the healing of the surgical wound, and results in considerable advantage to the patient. A gain of at

least two weeks is made in the application of external radiation, and no time is lost in the follow-up of postoperative treatment. Our study of the material removed at operation after this preoperative treatment shows that the surgeon has a less malignant type of tumor to deal with; the neoplastic cells show marked degenerative changes, and the replacement of tumor tissue by fibrous tissue indicates a reparative process. The atrophy of lymphatic channels aids materially in blocking dissemination of the disease. Treatment into the open wound is obviated, and its ideal accomplished, in a more thorough manner at an earlier date. Many cases at first belonging to the inoperable class are rendered operable.

The routine of our postoperative treatment is to give each patient three complete cycles at intervals of a month, following essentially the course of the preoperative cycle. In some instances the knowledge gained at the time of operation and by microscopic study of the material suggests broadening the field of radiation. In most cases the postoperative radiation is not given as rapidly as the preoperative cycle, for the obvious reason of lessening nausea and vomiting.

After the third cycle of postoperative radiation has been completed, the patient is usually placed under observation for a prolonged period, and no further treatment given for four to six months, and then a fourth cycle administered as an added precaution. However, this varies with the individual case and in the extremely malignant types it is best to keep up the monthly cycles for some time after the three months' period.

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A CASE OF PEDUNCULATED ADENO-CARCINOMA OF THE STOMACH AND POSSIBLE ERRORS IN DIAGNOSIS

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THE report of the following three cases was prompted by their roentgenologic similarity and the great possibility for error if proper attention is not given to our instructions in having the patients prepared for a gastro-intestinal study. In some cases only after a careful history and laboratory findings are we able to reach a conclusion. If the correct diagnosis is to be made, the roentgenologist, the surgeon and the clinician must cooperate.

CASE I. Male, aged thirty-one years. Admitted to the University Hospital November 12, 1919. C.C. Severe pain in upper abdomen. H.P.I. Admitted to Army Hospital May, 1918, on account of weakness. This weakness had taken two or three weeks to develop. His condition was diagnosed as pernicious anemia, and he was given five transfusions of 300 c.c. each. He was discharged from the hospital September 4, 1919. Very soon the patient noticed that he

FIG. 1. CASE I. ERECT EXPOSURE. Directly after the second opaque meal and six hours after the first meal, showing almost no contents in the intestinal tract.

FIG. 2. CASE I. NINETEEN HOURS AFTER PREVIOUS EXAMINATION, showing the amount of retention and the defect to perhaps better advantage.

FIG. 3. CASE I. SERIAL EXPOSURES IN THE PRONE POSTURE. The defect is quite noticeable in the dependent portion of the greater curvature. This did not interfere with the peristalsis.

was losing his appetite and suffered from some pain and distension in the epigastrium. The pain, however, did not bear any relation to meals. His physician gave him morphia for the pain, and after taking the morphia he was constipated. The remainder of the history was negative.

PHYSICAL EXAMINATION. — *Abdomen:* Visible peristalsis in upper abdomen near the umbilicus. A mass was felt under the right costal margin about the size of a hen's egg. It was hard, slightly tender and moved with respiration. Gastric analysis: 90 c.c., white, normal odor. Total acidity 10; free hydro-

chloric acid, 0; no occult blood. Wassermann, negative. Feces, trace occult blood.

ROENTGEN RAY FINDINGS. — *Stomach:* Moderate dilatation; obstruction, probably of duodenal origin; a permanent defect in the dependent portion of the greater curvature, probably papilloma or carcinoma, or even the possibility of a sarcoma. Peristalsis was quite marked throughout the examination. There were considerable opaque contents remaining in the stomach up to and beyond eighteen hours. The patient was not examined further than this. *Duodenum:* A constant filling defect strongly suggesting duodenal ulcer. *Colon:* Intestinal examination not carried out because of findings in the case of the stomach. The liver and spleen were found to be enlarged.

OPERATIVE FINDINGS.—Operation November 21st. Gastrotomy was performed near the growth, which measured 2 by 3 by 4 cm. and hung by a pedicle. It was removed because it only involved mucosa. Frozen sections showed the growth to be adeno-carcinoma. The gastrotomy opening was closed and a posterior gastro-enterostomy done. The defect in the duodenal cap was found to be due to adhesions to the liver at a point where there was a large nodular metastatic growth. There was no duodenal ulcer so far as could be ascertained, as the duodenum was not disturbed. The patient died December 12, 1919. (Figs. 1, 2, 3.)

CASE II. Female, aged forty-five. Admitted to the University Hospital October 31, 1919. Discharged November 9, 1919. C. C. Nervousness and occasional attacks of indigestion. H.P.I. The attacks of indigestion dated back fifteen years ago when she had an acute attack, coming on two months after delivery. During the attacks, which came on at irregular intervals, she had severe pain in the epigastrium, radiating upward equally to the two shoulders and making her feel short of breath. Vomiting relieved these attacks, so she took hot water to bring on emesis. The bowels were moderately consti-

FIG. 4. CASE II. ERECT POSTURE AFTER SECOND MEAL AND SIX HOURS AFTER FIRST, showing the irregular defect at the pyloric extremity.

FIG. 6. CASE II. ERECT POSTURE, SECOND EXAMINATION, showing no evidence of the defect previously noted.

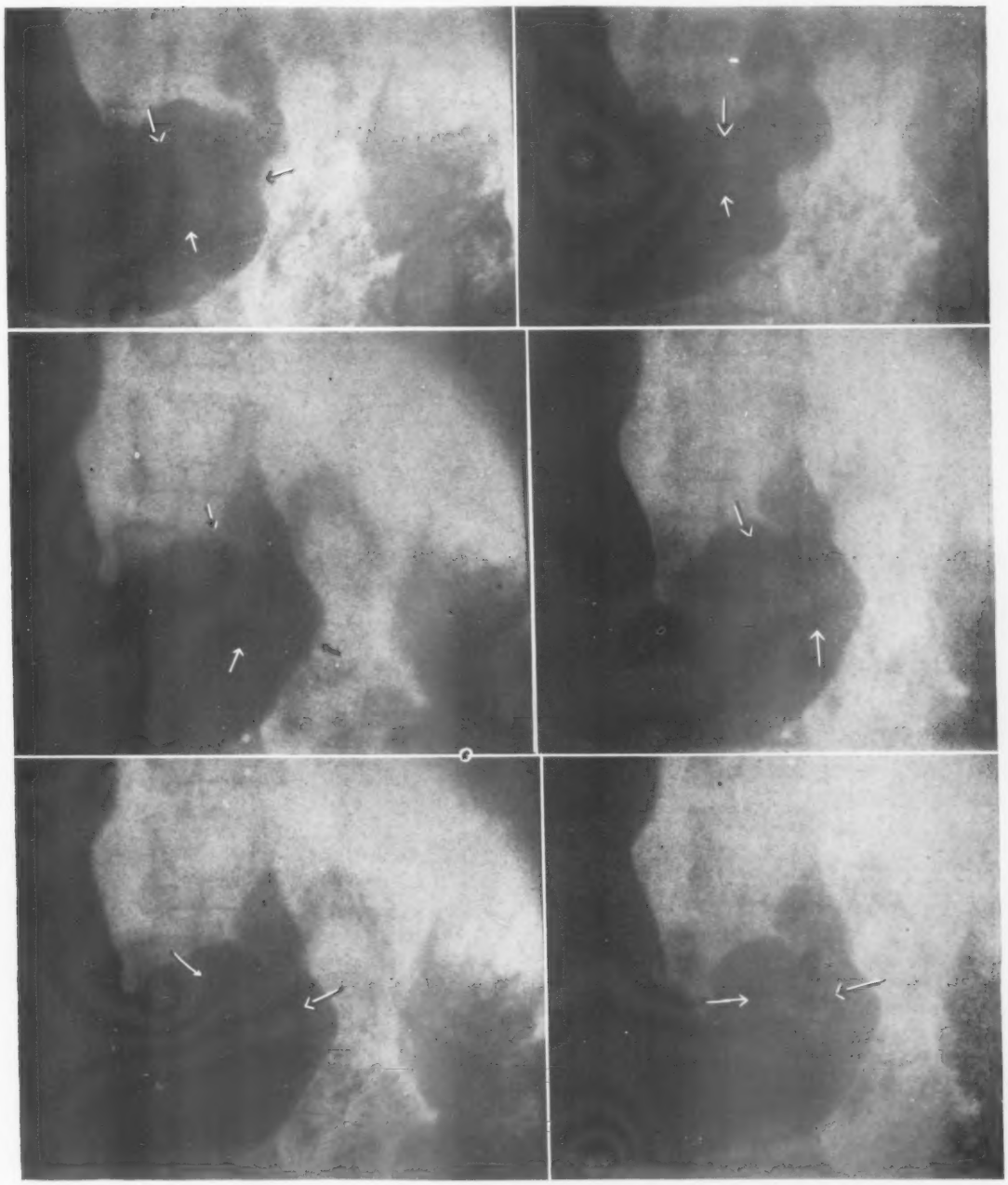

FIG. 5. CASE II. SERIAL EXPOSURES MADE IN THE PRONE POSTURE, showing the defect to better advantage but not showing extension.

pated always. There was never any jaundice. The remainder of the history was negative.

GASTRIC ANALYSIS.—White, normal odor. Trace of occult blood. Free hydrochloric acid, 6, 16, 28, 32, 20, 30, 20, 20, 20. Total acidity 26, 27, 45, 50, 40, 50 60, 40, 60.

ROENTGEN RAY FINDINGS.—*Stomach:* A moderate degree of ptosis. Slightly prolonged emptying time within six-hour period. A slight permanent defect, irregular in outline, at the pyloric extremity of the stomach found in every exposure in both erect and prone posture, suggesting a foreign body or a papilloma. The plates were

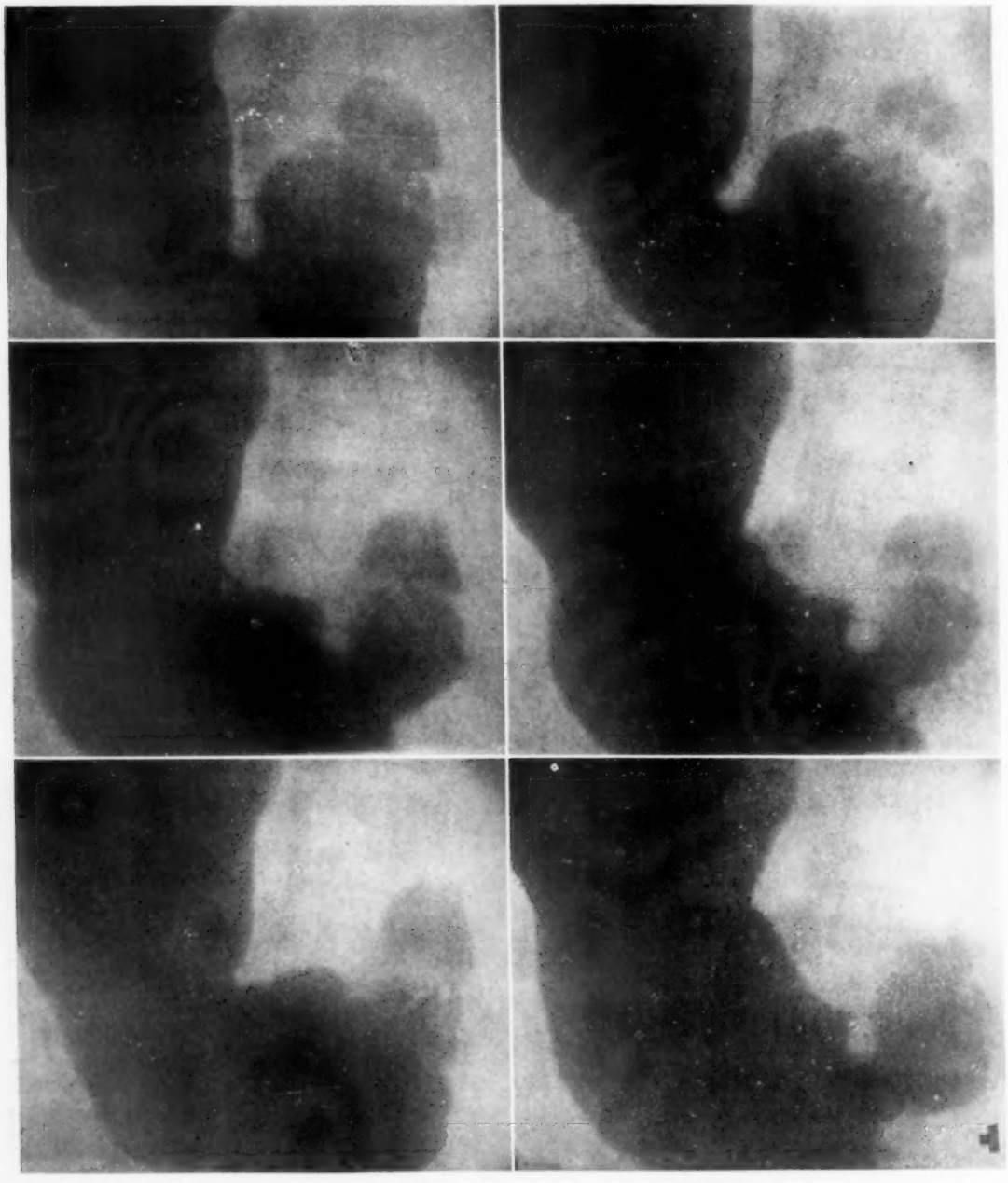

FIG. 7. CASE II. SERIAL EXPOSURES, SECOND EXAMINATION, showing no evidence of the defect.

examined by a number of visiting roentgenologists who concurred in this opinion. *Duodenum:* Negative. *Colon:* Ptosis of the right side and transverse colon. Decided stasis notwithstanding daily movements. Ileal stasis at the end of eighteen hours. The appendix was visualized, but there was no tenderness over it. Direct examination of the gall-bladder region showed three or four shadows which were very suggestive of gallstones. (Figs. 4, 5.)

A second examination was requested to confirm the diagnosis of the gastric condition. It was made eleven weeks after the first

FIG. 8. CASE III. FIRST EXAMINATION, DIRECTLY AFTER SECOND MEAL. Erect posture, showing defect in pyloric and stomach.

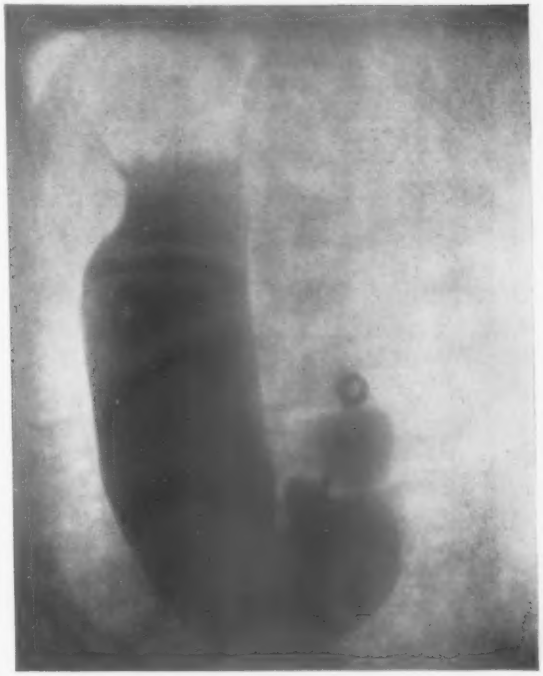

FIG. 9. CASE III. SECOND EXAMINATION, showing no evidence of the defect previously noted.

and showed no evidence of the filling defect noted at the previous examination. (Figs. 6, 7.)

CASE III. Female, aged forty-nine. C.C. Localized pain and feeling of obstruction. A diagnosis of gastroptosis, another of ptosed kidney, and lastly a neurasthenia syndrome with gastro-intestinal symptoms. She was anemic.

ROENTGEN FINDINGS.—*Stomach:* A moderate degree of ptosis and a moderate retention after six hours. Slight pyloric spasm. A permanent defect in the shadow of the stomach near the pyloric extremity in every exposure in both erect and prone postures. In view of the possible seriousness of this appearance a second examination was advisable. It was made three and a half weeks later and showed no evidence whatever of the defect previously noted. The same degree of ptosis and the same slight pyloric

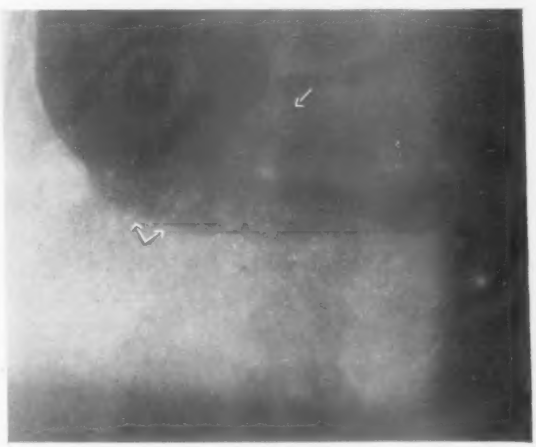

FIG. 10. ERECT POSTURE, DIRECTLY AFTER MEAL, showing irregular defect at the pyloric extremity due to whole grapes.

spasm were found. *Duodenum:* Negative. *Colon:* Ptosis of the entire structure and a very marked colonic stasis. Appendix visualized, but there was no tenderness over it. (Figs. 8, 9.)

All patients were examined according to

the double meal technique. In trying to find what would cause the above filling defects, we tried giving a patient some grapes with his breakfast. On examining him six hours later no filling defect was found. A second patient was asked to swallow the pulp of an orange and was examined six hours later and no filling defect was found. A third patient was given grapes, some of which were swallowed whole. He was examined directly after his grape lunch and large filling defects were found. (Fig. 10.)

The primary findings in Cases II and III prove that such appearances cannot always be taken as positive evidence of an organic lesion. A second examination is recommended, so that the first diagnosis may be confirmed or disproved. Sufficient time, three weeks usually, should be allowed to intervene in order to prevent any injury to the skin that might come from repeated roentgen ray exposure.

NOTES ON THE ROENTGEN TREATMENT OF LEUKEMIA,*

WITH REPORT OF A CASE UNDER TREATMENT FOR FOUR YEARS

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IN the treatment of leukemia the *x*-ray occupies a position of prominence, since this disease has proved especially amenable to radiation. If the patient is kept under observation and treatment renewed when recurrence occurs, he may maintain a reasonable degree of efficiency and be enabled to continue his work indefinitely.

Extensive experimentation has shown that those tissues of the body most responsive to the action of the *x*-ray are the blood, the spleen, the bone marrow and the lymph nodes. Leukemia has been termed a malignant disease of the blood, and the effect of the roentgen ray upon the blood and blood-forming organs would seem not incomparable to its effect upon the tissues of certain malignant growths. In normal animals subjected to radiation there is a noticeable destruction of the cells of the lymphoid tissue, spleen and bone marrow; but in addition there is, according to Capps and Smith, a production of leucolytic substances which have the power of destroying other leucocytes. These investigators discovered further that the serum of leukemic patients under *x*-ray treatment when injected into other leukemic patients caused a decided drop in the leucocyte count. On the other hand, the serum taken from patients before radiation had quite the opposite effect.

Melchener and Wolff in their experiments on the causation of leukemia found that healthy animals injected with the serum made from spleen which had been subjected to radiation, exhibited a marked reduction of the leucocytes; while an injection from spleen that had not been irradiated produced a leucocytosis. Thus it would seem that the benefit derived from radiation in leukemia is not alone due to a destructive action on the blood and blood-forming organs, but to certain leucolytic substances that are in some manner produced by the treatment.

The best results in the treatment of leukemia by the roentgen rays have been secured by first exposing the long bones to radiation, and later the spleen. With this method the reduction of the leucocytes is slow but more permanent. Following treatment of the long bones there will be found at least a moderate reduction in the size of the spleen. In some instances the spleen has been reduced to normal size by treatment to the

*Thesis presented with application for membership in THE AMERICAN ROENTGEN RAY SOCIETY, 1920.

long bones alone. When radiation is applied directly to the spleen there usually results a slight rise in the leucocyte count as well as some evidences of a toxemia. Less toxemia will result if only two or three small areas are treated each day; the leucocyte count will be reduced rapidly enough.

The applications should cover a period of ten to fourteen days, when, if the dosage has been sufficient, the leucocyte count should fall to near 20,000, and the spleen should be considerably reduced. The series should not be repeated under three to four weeks, and not then unless the size of the spleen and the blood count would indicate a recurrence. In many instances it has been found that two to four series a year have been sufficient to keep the patient in a fair state of health.

TABLE I.

	Red Cells		*White Cells*		
Date	Hemoglobin	No. per c. m.	per cent	No. per c. m.	per cent
7/19/16	(Treatment was begun on this date)				
7/26/16	75	4,100,000	82	142,500	1,900
8/2/16	75	3,800,000	76	174,000	2,320
8/9/16	80	4,200,000	84	51,000	680
8/16/16	70	3,350,000	74	9,000	120
8/23/16	80	4,300,000	86	6,700	90
	(Treatment was discontinued on this date.)				
9/3/16	85	4,500,000	90	28,500	380
9/10/16	80	4,500,000	90	72,000	960
9/13/16	80	4,500,000	90	112,500	1,500
9/17/16	70	3,900,000	78	43,500	580
9/20/16	70	3,500,000	70	35,000	400
	(Treatment was again begun on this date)				
9/24/16	82	4,400,000	88	35,000	400
9/27/16	76	4,200,000	84	15,000	200
10/11/16	78	3,800,000	84	9,000	120
10/14/16	86	4,300,000	86	14,200	190

To illustrate the more flattering results that may be obtained, I wish to report one case which has been under observation and treatment for about four years at the Battle Creek Sanitarium.

CASE No. 129543; male; American; white; age forty-nine; attorney. The patient had all the diseases of childhood, and had a mild malaria at intervals for twenty-five years. Six months previous to the time he came under observation in the *x*-ray department (July 6, 1916) the patient noticed that he became exhausted easily, that he felt tired and did not want to work, and had lost about fifteen pounds in weight. He had no gastric symptoms, but a certain distress in the abdomen due, he states, to the pressure caused by the enlarged spleen. The patient's attending physician made a diagnosis of splenic leukemia. He was put on large doses of arsenic for three months. When the patient arrived at the Battle Creek Sanitarium his blood count showed the white cells to be below 5,000, but in less than two weeks the white cell count had gone up to 142,500. Physical examination revealed a man with nutrition below par; skin of a bronze color with sallow mottling over the abdomen. The muscles were poorly nourished. The liver was enlarged, and the splenic dullness extended from the 5th interspace to the level of the umbilicus. Mucous membrane pale and skin reflexes sluggish.

Treatment was begun by Dr. James T. Case in July, 1916. It consisted of 25 milliampere minutes at a 9-in air gap, with a focus-skin distance of 7 inches and 4 millimeters of aluminum and a piece of sole leather used as a filter. Treatment was first applied to the long bones and afterwards to the spleen by the cross-fire method, the total dosage for the series being as nearly as possible 150 x units measured underneath all

the filters. Kienbock pastilles were used for estimation of dosage. The second series was begun September 20th. Following this series of treatments the white blood count was almost normal; in fact the entire blood examination showed an almost normal condition. After this the patient returned home and for nearly a year there were no symptoms. The report of the attending physician on the condition of the patient at this time was: "He has made wonderful improvement generally. The spleen has receded to practically normal size. The blood is normal for a greater part of the time, but there is a tendency to leukocytosis at times."

In July of 1918 the patient again returned for treatment. Physical examination showed a very low state of nutrition, skin lemon tinted and patient apparently very anemic. He showed considerable edema, especially of the legs and face. The muscles were flabby and wasted. The pulse was 120. The spleen was markedly enlarged, extending from the 6th rib to below the costal margin.

Two series of treatments were given, treating the proximal ends of the long bones and the spleen. Fifteen x units were administered (23 milliampere minutes, focus-skin distance 7 inches, 5 milliameters of aluminum and sole leather filter). The physician's report at the end of the treatment stated: "The patient reacted to his treatment very satisfactorily. At the time of his arrival his percentage of white cells was 1,900 and later 1,795, but at the time of his departure was down to 140 and had been as low as 100 per cent. His strength improved very materially and his red blood cells had increased from 2,500,000 to 3,400,000 and his hemoglobin from 48 to 60. The edema had entirely disappeared and his strength was very much better. The spleen was reduced to normal size."

TABLE II.

	Red Cells		*White Cells*		
Date	Hemoglobin	No. per c. m.	per cent	No. per c. m.	per cent
7/20/17	80	3,900,000	78	225,000	2,500
7/25/17	75	3,800,000	76	47,600	3,000
7/27/17	76	4,300,000	87	187,500	635
8/1/17	85	4,200,000	84	43,500	580
8/12/17	77	4,000,000	80	56,200	750
8/17/17	77	4,100,000	82	60,000	800
8/23/17	77	4,200,000	84	65,000	800

The accompanying table will show the blood changes during the three series of treatments in 1916. (See Table I.)

In July, 1917, the patient returned with a white cell count of 150,000 to 225,000. A third series of treatments was begun July 22, and a fourth August 14. After these two series the blood became practically normal, the white cell count being 13,000. The patient had gained in weight and strength and there was a great reduction in the size of the spleen.

The blood changes during the series of treatments in 1917 are shown in the accompanying table. (See Table II.)

Table III shows blood changes during treatment in 1918:

TABLE III.

	Red Cells		*White Cells*		
Date	Hemoglobin	No. per c. m.	per cent	No. per c. m.	per cent
7/4/18	48	2,500,000	50	142,500	1,900
7/18/18	50	3,200,000	64	102,000	1,360
7/25/18	60	2,600,000	52	75,700	1,010
7/31/18	55	3,200,000	64	130,100	1,735
8/1/18	55	3,100,000	62	134,600	1,795
8/7/18	55	3,000,000	60	69,700	930

The patient returned again for examination in April, 1919. Since his treatment in the previous year he had remained subjectively very well. His strength had been very good and he had been busily at work most of the time. However, a few weeks before returning here he noticed that his spleen had begun to enlarge and he thought it best to appear for a new examination. *X*-ray treatments were begun on May 1st, 1919, with the results which are here shown in Table IV.

TABLE IV.

	Red Cells		*White Cells*		
Date	Hemoglobin	No. per c. m.	per cent	No. per c. m.	per cent
5/4/19	60	2,500,000	50	91,800	1,225
5/8/19	40	3,200,000	64	145,000	1,940
5/11/19	50	3,000,000	60	105,850	1,400
5/27/19	55	3,500,000	70	94,000	1,310
	48	3,400,000	68	66,000	800
	52	3,500,000	70	54,000	730

The patient came back again February 12, 1920, for further treatment. After going home in September he continued to feel subjectively well and gained considerable weight. After about three months the spleen began to enlarge, and he noticed a loss of weight. In all he had fallen off 26 pounds since leaving here last time. His appetite had become poor, especially during the last month, and there had been a gradual diminution in strength. For the last two or three weeks he had not been sleeping so well. The bowels had become loose.

Physical Examination.—Nutrition below par. Skin rather lemon tinted. Muscles decidedly poor in nutrition. Skin dry and poorly nourished. Tongue clean. Sclera muddy and subicteric. Pulse rapid, regular. Heart somewhat enlarged downward and to the left; valves negative. Breath sounds rather increased in intensity posteriorly. Spleen enormously enlarged, extending from the eighth rib to three inches below the umbilicus and two and a half inches to the right of the umbilicus. Liver enlarged, extending from the fifth interspace to below the costal margin. Kidneys not palpable. No marked abdominal tenderness. Skin reflexes sluggish. Knee jerks decidedly sluggish. Weight about 130 pounds.

One series of treatments was given, paying special attention to the proximal ends of the long bones, after which the spleen was treated by the usual cross-fire method. When the treatment was started the white blood count was 206,200. A few days after the series was completed the last blood count was taken, which showed a white count of 67,000. The spleen had materially decreased in size, but not to normal. The patient's general condition had decidedly improved and he had gained several pounds in weight.

SUMMARY.

1. It would seem that the benefit derived from radiation in leukemia is due not alone to the destructive action on the blood and blood-forming organs, but to certain leucolytic substances that are in some manner produced by the treatment.

2. By applying the treatment to the long bones first, there is a more gradual but more lasting reduction of the leucocytes with less toxic effect than when the treatment is applied to the spleen first.

3. During the course of the *x*-ray treatment there is usually noted a slight initial rise of the leucocytes, followed by a gradual reduction of the white count, with an increase of the red cells.

4. It is observed that leukemia usually does not respond so readily to treatment after the first or second series.

RADIUM ELEMENT VERSUS EMANATION*

By ALBERT SOILAND, M.D., F.A.C.P.

LOS ANGELES, CALIFORNIA

THIS argument will be based upon the writer's personal knowledge of the use of radium element and upon his observation of the radium emanation method in the hands of well known radiologists. It is admittedly difficult to be wholly impartial when one essays a comparison between two methods that are expected to reach the same result, if he is trained to the use of one of these only. Nevertheless, absolute fairness, to the extent of the writer's ability to observe it, will prevail, and it is hoped that a free and frank discussion of the relative merits of the two methods will follow.

From time to time certain remarks will reach the ear of the radium worker with element, that he is out of date, that only with emanation needles can really scientific work be effected. While such remarks are irrelevant and will perhaps not concern us greatly, yet when our patients inquire of us as to the correctness of such rumors, they take on a more serious aspect, particularly for those among us who are working with limited amounts of radium element. It is to be hoped that no one associated with our scientific societies will permit such insinuations to pass by unchallenged.

A comparison of the use of element with that of emanation can be made from two angles, the financial and the clinical. It is principally the latter that we shall deal with here. The financial side of the question offers slight ground for debate. One either can, or cannot, afford to invest a sum of money sufficiently large to cover a complete emanation station. If one is more or less limited in his finances and has to bear the burden of expense alone, his investment in radium will more than likely be considerably under one gram of this precious mineral, and this will be in one of the insoluble salts. If money is plentiful, or an endowment available, the result will of course be one gram or more of radium in solution. From a standpoint of gross utility alone, one has no business with so large an amount of radium in any other form than solution. Radium in quantities less than a gram does not lend itself readily for emanation purposes. It is then best applied in the various forms of tubes, needles and plaques, now so conveniently arranged by the manufacturers with accessory appliances for therapeutic use.

From the clinical side, both radium element and radium emanation have their quota of supporters, some of whom claim specific virtues for their favorite method. It is assumed that all accept as a basic fact the cardinal point that it makes no difference in the final result of every radium treatment, whether element or emanation is used, provided the duration of the period of radioactive units is the same during the exposure.

There are three distinct advantages with emanation, namely: the ability to make fractional dose units easily; the convenience of imbedding such units into tumor tissue; and the great fact that the parent radium is always safely ensconced in a protected sealed chamber, free from all kinds of molestation. The latter is the main point of advantage; for no matter whether a single emanation needle or any number of these are lost, either in the tissues or elsewhere, the operator knows that no serious results will follow, owing to the limited time of radio-activity possessed by the radium gas. Of importance, also, is the fact that no particular monetary loss has been occasioned. Upon merely a brief analysis the three named points of apparent superiority seem quite insurmountable to the advocate of the element method. A little closer inspection, however, shows that they are not so formidable. True, the fact that one can lose or destroy the emana-

* Read before the Pacific Section of THE AMERICAN ROENTGEN RAY SOCIETY, Catalina Island, California, June 17-19, 1920.

tion needle without feeling the loss of the parent radium, is of itself one great dominating factor that cannot be contradicted in any way. But in regard to the first two points of superiority claimed for the emanation method, the advantage is not so marked, although the use of radium element is, in these respects, somewhat less convenient. In the face of the foregoing admissions, what can the advocate of radium element offer for his method? If he is of the proper caliber, he will probably concede that he is using element largely because he is unable to command an emanation plant.

However, from the standpoint of applied therapy, there are certain advantages in using the elemental form of radium. In the first place, it is considerably easier to employ. Again, the calculation of an ever changing and depreciating millicurie standard is avoided. Third, the milligram unit of activity in radium element being constant and stable, permits of a simplified and more accurate dosage at all times. The additional fact that one is compelled to watch more closely the implanted element tube or imbedded element needle, calls for even greater care in the supervision of the patients so treated. This point is worthy of reflection.

What is the minimum amount of radium with which one can attempt comprehensive radium therapy? This question is not easily answered, much depending upon the number of patients treated during the same period. The writer will venture the statement that not less than 100 milligrams can be considered. It has happened that physicians with radium in their possession, in amount not exceeding 25 milligrams, have made known by means of printed announcements sent to the profession that they were prepared to handle referred radium work. Such instances are happily rare, but if encouraged will surely lower standards in a way similar to that done by *x*-ray operators of a former day, who with inferior apparatus and extremely limited knowledge attempted all sorts of impossible diagnoses and treatments, and thus brought about a state of affairs that even in this day of highly specialized apparatus and modern technique we are yet stigmatized for.

Radium therapy, whether by element or emanation, has now fully weathered the experimental stage. A number of influential medical men still look upon it with disfavor; but careful and conscientious work, as exemplified by that of our radiological societies, has amply demonstrated the increasing scope of its usefulness. It matters nothing to the patient whether radium element or radium emanation is used in his individual case, pro-

ELEMENT	EMANATION
Is available in small amounts.	Requires an investment of $100,000 or over.
Can be used quite extensively and with an investment from $20,000 to $50,000.	Sealed in vault, requires no insurance, but expense for quarters greater and cost of skilled help increases overhead expenses.
Requires less space for operation, but requires a 2 per cent insurance carriage.	Loss of emanation needles of no monetary significance and limited radiation period makes loss in tissues immaterial.
Tubes, needles and plaques bearing parent radium must be carefully protected from loss in tissues to avoid over action.	Has a distinct time limit of activity and a varying loss of its energy until spent.
Has unvarying output of energy of ratiotion.	Can be made up in any form desirable to suit each individual case. A distinct advantage.
Can be obtained in suitable form of applicators to meet any requirements.	Technique is more complicated.
Dosage easily computed.	Results not so readily duplicated, owing to more work necessary to match applicators.
Technique easily acquired.	
Results readily duplicated.	

Results: R element and R emanation exactly alike if equal energy of radiation is used.

vided he gets results; and, in the final analysis, that which does the work is the sum total of the energy of radiation.

Therefore, let us continue the study and scientific application of the material we have in hand, confident in the knowledge that radium has done more to assist surgery and the roentgen ray in combating malignancy than any other therapeutic agent known at the present time.

SPRING-CLIP FOR HOLDING X-RAY FILMS ON THE ILLUMINATION BOX

By GEORGE E. PFAHLER, M.D.

PHILADELPHIA, PENNSYLVANIA

IN the transition from plates to films in roentgenographic work, much difficulty has been encountered in holding the films in a satisfactory position on the illumination box, and I have seen nothing on the market that accomplishes this effectively.

FIG. 1. SHOWS CLIP IN REVERSE POSITION so as to demonstrate the hairpin curve to which the screw and washer are attached.

FIG. 2. SHOWS THE CLIP HOLDING A DENTAL FILM. It will hold a 14 x 17 equally well.

FIG. 3. SHOWS A LATERAL VIEW OF THE SPRING CLIP BESIDE A TAPE MEASURE, giving relative dimensions.

With the aid of my mechanic a successful spring-clip has been developed to be attached to the upper border of the illumination box at intervals of four inches. The clip is made of spring wire No. 17 gauge, bent in the shape shown in the illustration. The spring-clip measures 1¼ inches from its shank to the circle, and 1¼ inches from the circle to the lower curve. This size will vary somewhat with the depth of the glass from the frame of the illumination box. The spring is attached to the wood at the top of the illumination space by means of a screw and washer. When these clips are connected one can simply push the film under the clip without even touching the clip, and there is sufficient tension on the spring to hold the film in place. It eliminates any curling or movement of the film while marking or writing on it, and when it is ready for removal one only needs to take hold of it and pull it out. With reasonable care there is no scratching of the film. The springs will have to be modified somewhat according to the depth of the glass from the surface of the wood; but this can probably all be accomplished merely by increasing or decreasing the tension of the spring, and aside from this there is nothing to do except put the screws in place and attach the spring. It is inexpensive and efficient.

This spring-clip has been admired by roentgenologists and others who have visited my office during the past year, and I have therefore concluded that it would probably be of general interest to roentgenologists.

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ANNUAL MEETING EASTERN SECTION

The Second Annual Meeting of the Eastern Section of The American Roentgen Ray Society will be held in Atlantic City at Haddon Hall-Chalfonte, on Friday evening and Saturday, Jan. 28, 29, 1921. Make hotel reservations early, mentioning American Roentgen Ray Society.

Communications regarding the program should be addressed to Dr. David R. Bowen, 82 West LaCrosse Ave., Lansdowne, Pennsylvania.

In all other matters concerning this meeting, address Dr. Joseph M. Steiner, 103 Park Ave., New York City.

ANNUAL MEETING CENTRAL SECTION A. R. R. S.

The Second Annual Meeting of the Central Section of THE AMERICAN ROENTGEN RAY SOCIETY will be held on February 21, 1921, at St. Louis, Missouri. Announcement of headquarters will be made later.

Communications regarding the program should be addressed to the president, Dr. James G. Van Zwaluwenburg, Ann Arbor, Michigan. The chairman of the local committee, Dr. Edwin C. Ernst, 412 Humbolt Building, St. Louis, may be addressed concerning matters of arrangements.

ADVANTAGES OF GROUP MEDICINE TO ROENTGENOLOGISTS

THE one big advantage to any specialty by inclusion in a large group clinic is in the establishment of values. It is not essential that original work be produced by the specialty represented in such a clinic; rather would one hope that the representing specialist will be interested in demonstrating the routine values of a diagnostic procedure or treatment upon a percentage basis.

The isolated specialist is able to produce original ideas, and he may accomplish results in a long list of successful cases which would seem to establish his method. Nevertheless, if this original idea is taken up, thoroughly analyzed, mercilessly debated by a staff, and routinely applied in an unprejudiced manner over a period of time upon a large number of patients, the true values will eventually be demonstrated in a much shorter space of time than if the majority of the profession was apprised of the method or idea through the literature and it was applied in an indifferent manner upon a few cases over a long space of time.

There are several brilliant groups devoted to clinical medicine and surgery in America. There are several hospital staffs which apparently cooperate as a group of specialists. It is interesting to observe that where the roentgenologist of such a group or hospital is a physician of sound judgment of a cooperative disposition, that roentgenology has gained values which have increased the usefulness of the specialty throughout the world.

It is not necessary to cite examples, but it is interesting. One does not need to state the name or the place in citing examples, but anyone familiar with the literature of roentgenology will not find it difficult to place the honors.

The idea of direct duodenal diagnosis originated in an efficient isolated roentgenologist's brain who proved his point to the satisfaction of other roentgenologists long before this method of duodenal diagnosis was comprehended by the general profession. It was proven to the satisfaction of the entire profession through its routine use in a large clinic where its percentage values were under the constant scrutiny of operating surgeon and examining clinician.

The idea of radiographing the sella turcica has not been new since the earlier years of our specialty, but the values were not conclusively demonstrated until the method was routinely used in a large clinic where this class of case was seen daily so that a mass of data was evolved that established values.

The idea of treating enlarged thymus by means of radiotherapy was sporadically applied throughout the world; but it remained for one clinic to analyze or treat or both analyze and treat every case of mediastinal enlargement in babies or children and demonstrate the effectiveness of such treatment to a majority of the profession.

At the present time there are several problems in roentgenology that have not been clearly demonstrated to the entire profession, and neither have they been routinely applied in several large clinics—gall-bladder roentgenology, appendiceal roentgenology, mastoid roentgenology. Each of these subjects has a splendid literature and every roentgenologist probably has his own ideas as to the inherent values of each; but there has never been any routine group analysis of their roentgen values upon a percentage basis with a cold calculating estimation of their importance in the completed case history. An unbroken tabulation of 5,000 cases as these cases come to a clinic is necessary; a similar unbroken tabulation by a single roentgenologist would not do—the latter would only have those cases whose symptoms prompted a roentgen examination.

There is another advantage to group clinic efforts; they furnish a reliable school of instruction in a specialty. Such clinics can demand that those applying for instruction in a specialty shall devote ample time really to digest the rudiments and gain a vision of the future possibilities and think in their chosen field. Such graduated instruction can also demand that the specialist accept contemporary instruction in other fields of medicine, so that his viewpoint will not be cramped and confined within the limits of one specialty. The student will always be served with the glowing example of cooperation that is constantly about, and he will learn to grasp his subject all the more firmly through the constant discussions and dissensions among the leaders of the group. He will be constantly establishing his values.

There is one disadvantage of the group system, and this should be considered by anyone who is contemplating allying himself thusly for the practice of medicine. Groups stifle individuality. Groups will never originate a genius. Groups attach individuals to themselves and engage the services of geniuses to their advantage and sometimes to the pecuniary advantage of the genius. Advancement in any branch of science, invention and knowledge depend upon the hypothetical vision of enthusiasts and dreamers. This is not for the group worker, for he must constantly apply himself to establishment of the values to group practice

of the visionary or enthusiastic problems of the isolated worker. The scrutiny of the group clips the wings of romaqntic scientific flight and forces reactionary conservatism.

Fortunately the practice of medicine or any of its specialties does not alter the disposition or the mental bent of the man, and therefore there will always be available physicians for group practice and for isolated practice. They are both necessary. One serves as a check upon the other. The disposition is the determining factor. Character, integrity and knowledge of his specialty are the common possession of each type.

E. H. S.

COMMUNICATION

To the Editor of THE AMERICAN JOURNAL OF ROENTGENOLOGY:

In the June, 1920, issue of the JOURNAL is an interesting article by Potter on the Bucky diaphragm principle applied to roentgenography. He described a simple, uniplanar grid which is mounted on bearings, made to run on a curved track with a very ingenious device for the control of the roller movement. Bucky in his description and in his work utilized the grid in a manner somewhat similar, but neither so ingeniously nor so practically as does Potter. I know that Bucky had used this simplified screen of parallel plates without cross members, though he found it less effacious than the "honeycomb." I have also had occasion to see some of the experimental work of Potter and am certain the apparatus he has evolved is of great value for the obtaining of a finer definition in the radiograph of deep structures.

There exists so much confusion regarding the nature of the Bucky diaphragm and its method of application that I am tempted to utilize your valuable space for a review of Bucky's work.

The prevention of the fogging of the recording surface by secondary and scattered radiations has been an ever recurring problem of roentgenology, and the nearest approach to any method for their radical removal has been made by Bucky in 1913. According to his invention there is placed between the sensitive plate or screen and the body a grid of interlaced strips of metal, making a sort of screen of many chambers, not unlike in structure to a honeycomb. The walls of these chambers are so arranged that they are parallel to the direction of the primary rays and do not obstruct their passage.

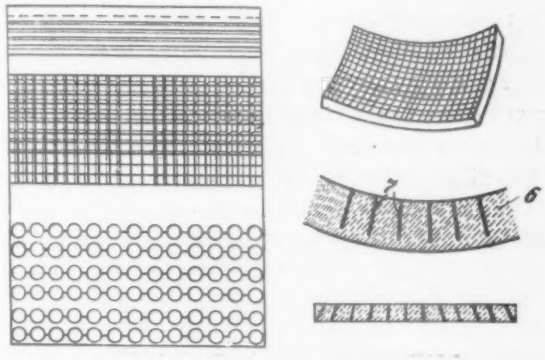

FIG. 1. In the upper part of the figure there are shown parallel and unidirectional walls, forming the ducts or chambers of the grid. In the middle, part of a grid is shown which consists of walls intersecting each other rectangularly, so that individual ducts or chambers of rectangular cross section will result.

In the lower part a construction of the ducts of chambers of the grid is shown, whereby cylindrically bent metal sheets are used for making the chambers or ducts of the grid, the metal sheets being connected with each other by short connecting bridges, as indicated in the drawing.

FIG. 2. In the upper part of the figure is shown a grid having the shape of a section of the shell of a cylinder. In this form, because of being able to obtain radially directed walls the chambers may be made very narrow and the grid itself thin. In the middle part of the figure is shown a cross section of such a curved grid, with parallel plates without cross members.

In the lower part of the figure is shown the cross section of a flat grid, which has been made from the grid represented in the middle figure by planing down until two flat, parallel surfaces are obtained.

The material of this grid is usually such a substance as completely absorbs the rays. The function of the grid is to absorb the scattered rays emerging from the body before these reach the recording surface.

Bucky states that the grid can be of plain or spherical form, and that the grid may be suitably mounted, provided with a contriv-

ance for imparting to it either linear, oscillating, circular, elliptical or any similar motion, so that the shadows which are cast by the grid will not affect the roentgen image of the part radiographed. He also suggests a device for accurately adjusting the tube upon the center of the grid, the distance corresponding to the inclination of the walls of the chambers and the position of the anticathode such as to be at the point of intersection of the planes of the walls of the grid. The device for imparting motion to the grid is such that each point of the grid will describe a circular path, the diameter of the circle of motion being equal to the length of the side of the smallest square of the grid. The velocity of the drive, he points out, must be such that the walls of the grid will not cast a visible shadow on the plate or screen. He suggests that the motive power may be furnished by a hand-crank, a clock fork or a motor.

Bucky suggests that a simple way of making a grid is to take a piece of celluloid (½ to ¾ in. thick) in which parallel cuts are made, one fourth, one sixth or one eighth of an inch apart. These cuts are filled in with lead salts bound in a proper medium. The plate may now be given a cylindrical shape or further modified as shown in Figure 2. It is thus apparent that Bucky has amply described all the possible variations of this "filter" which will undoubtedly prove a very valuable radiographic and fluoroscopic accessory.

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TRANSLATIONS & ABSTRACTS

COFIELD, ROBERT B. Some Difficulties in the Diagnosis of Osteosarcoma. (*J. Am. M. Assn.*, Vol. lxxv, No. 19.)

Medullary type is more infusing than the periosteal, and that involving the short bones and vertebrae more difficult of diagnosis than when long bones are involved. He says the following concerning the roentgen ray examination:

While the roentgenogram is one of the most important adjuncts in differentiating bone diseases, it is often impossible to make a diagnosis, by the roentgen ray alone, in the early or atypical cases of osteosarcoma. It may necessitate serial examinations as well as a careful study of the full clinical data, and occasionally an exploratory incision to be positive of the true nature of the disease.

The roentgen ray picture of central sarcoma of the long bones is one of irregular destruction, with little or no tendency toward new bone formation until the periosteum is involved or broken through. The lesion is usually confined to one area, although multiple lesions are occasionally observed. Medullary sarcoma in the beginning may be confused with myeloma, cyst and osteomyelitis. Since they frequently have the same point of origin and are more or less destructive in character, it may require repeated roentgen ray examinations to differentiate these conditions. In myeloma, the globular outline of the tumor is maintained during its expansion; the swelling shows little or no tendency to extend along the shaft or break through its capsule and invade the surrounding tissues and, when completely removed, does not recur or produce metastasis; myeloma was formerly classified as a nonmalignant giant cell sarcoma, and is probably the same condition as described by Barrie under the title "chronic hemorrhagic osteomyelitis." In cysts, the cell wall is usually sharply outlined and clearly defined, and shows no tendency toward rapid expansion and invasion.

In suppurative osteomyelitis the roentgen ray findings are often not definite enough in the beginning to make a diagnosis; but as the disease progresses, the inflammatory redness of the skin appearing over the rapidly growing tumor would suggest a pus infection rather than malignancy.

Sarcoma involving the spine may portray an expansive tumor of the vertebrae simulating a circumscribed abscess when viewed in the anteroposterior position; and at the same time a lateral view may reveal the crushing of the vertebral bodies, as seen in Pott's disease. In other cases the extensive destruction of the vertebrae, accompanied by more or less hyperplasia of bone, may resemble syphilitic spondylitis. The severe pain, which is not relieved by fixation, the rapid invasion of the surrounding tissues and the early involvement of the spinal cord, with a resulting paraplegia, strongly suggest malignancy.

The roentgen ray picture of periosteal sarcoma is more distinctive in character, the new bone formation showing a trabeculation or spiculation at right angles with the shaft of the bone and presenting a smoky appearance. Early in its court it may be mistaken for osteoma, osteochondroma and myositis ossificans. Osteoma and exostoses are readily recognized, as they are conical or pedunculated, and their sharp outline is continuous with the bone from which they arise. Osteochondroma, when growing from the epiphysis laterally, gives a rather typical appearance; when of central origin it is more confusing. Either form may at any time take on the characteristics of malignancy, indicated by rapid growth and destruction of the enveloping capsule.

Myositis ossificans and ossifying hematoma, the latter occurring in subperiosteal hemorrhage from injury or scurvy, show a definite bony border due to the deposit of calcium salts, and the bone is laid down parallel to the shaft rather than perpendicular, as seen in periosteal sarcoma.

The diagnosis is most difficult when a rapidly growing periosteal sarcoma invades the adjacent joint; as the disease spreads to the joint capsule and periarticular tissues, the joint takes on a fusiform shape and symptoms

simulating a tuberculous, syphilitic or hemophilic lesion, the latter particularly when blood is aspirated from the joint.

Carcinoma of the osseous system is rarely confused with sarcoma, since carcinoma is of metastatic origin and always secondary to cancer elsewhere in the body; when occurring in bone, it usually attacks the cancellous tissue first and shows areas of regeneration along with the destructive process. I have seen a pathologic fracture of the femur heal under the influence of mechanical fixation only to break down again after the support was removed.

COLLIN, E. Radiotherapy in Sweden. (*Hospitalstidende, Copenhagen*, Aug. 25, 1920, Vol. lxiii, No. 34, p. 521.)

Collin says that the history of radiotherapy in Sweden is the history of one man, Prof. G. Forssel, of the chair of medical radiology at Stockholm. Since 1911, when the Radium Home was founded, the annual number of applicants for treatment has increased from 332 to 1,541. The results with inoperable cancer, he says, have been such that they "not only justify further research but they make the application and development of radium treatment of cancer a bounden duty." Collin's review of the technic and results concludes with the statement that what has been accomplished there with radium is far ahead of what has been realized in Denmark, while the achievements with roentgen irradiation are about the same in the two countries, but Denmark is far ahead in the matter of light treatment. Forssel insists that no one man can master both roentgen diagnosis and roentgen treatment. He reports 28 per cent of the cases of uterine cancer cured after a five year interval; the surgeons count only on 18 per cent cured of the operable cases after the same interval. The cancers treated included 94 per cent inoperable cases.

MEDICO-LEGAL. Circumstantial Authentication of Roentgenogram—Admissible Evidence When Roentgenogram is Lost. (*Quinn v. Flesher W. Va.*, 102 S. E. R. 300. *J. Am. M. Assn.*, Vol. lxxv, No. 2.)

The Supreme Court of Appeals of West Virginia says that, in this personal injury case, the roentgenologist, who made a roentgenogram of the plaintiff's injured hip, and another physician examined the plate after it was developed, and determined from the information received from the plate and from an examination of the injured leg that there was a fracture of the hip bone. After that the plate was mislaid, and it could not be found at the time of the trial, although thorough search was made for it. Still these physicians were permitted to testify that it disclosed a fractured hip bone. The defendants contended that this was error, first, because it was not shown that the roentgenogram was so taken as to represent correctly the object sought to be photographed; and, secondly, because the roentgenogram itself being secondary evidence and it being lost, no testimony could be offered based on a view of it. But the court holds that there was no error in either respect.

It is quite true that before a roentgenogram can be used as evidence it must appear that it was so taken as to represent correctly the object reproduced. Of course, it is not meant by this that some one must testify that it is in fact a correct representation. Manifestly, this would be impossible for the reason that the object thus photographed is not visible except with the aid of the roentgen ray machine. What is meant is that it must appear that the machine was so placed as to reproduce correctly the object brought within the radius of its activity. Nor need this necessarily appear by a direct statement of the operator to this effect, although it may be, and ordinarily is, shown in that way. It may, however, as well be shown from a detail of the circumstances. In this case the physician who took the roentgenogram was shown to be an expert with large experience in this work. The picture was taken with a view of determining the nature and extent of the plaintiff's injury with a view to treating it, and treatment was administered for the relief of the injury which the roentgenogram disclosed, with favorable resu'ts. This might not prove absolutely that the plaintiff was injured as disclosed by the roentgenogram, but the fact that the injury sustained by her responded to the treatment ordinarily administered for the relief of an injury such as that shown by the roentgenogram was, to say the least, very strong evidence that her injury was of that character, and sufficiently

authenticated the roentgenogram to justify its admission in evidence.

Was it proper for the two physicians who examined this roentgenogram to testify as to what it indicated? It seems to be very generally held that, where the original of a document is lost, a copy made from a copy may be introduced in evidence on a showing of the correctness of the first copy and the loss thereof. It is the best evidence obtainable. In this case, if we treat the roentgenogram as but a copy of the then existing condition, we have the original, which was the condition of the bone at the time, lost by a change in the conditions due to a lapse of time and the treatment administered, the only reproduction of that condition is lost, and the best evidence obtainable as to what condition actually existed at that time is the impression made on the minds of the two physicians from their examination of the plaintiff's hip and the roentgenogram thereof. It was not error to admit this evidence.

Furthermore, the court holds that where, after the trial of an action to recover damages for injuries sustained from a broken bone has been entered on, the defendant requests that a roentgenogram be made of the injured member, and the plaintiff is willing that it should be done, it is not error for the court to refuse such request where no reason is given for not having made the same before the trial, and it does not appear how long the trial will be delayed by granting such request.

BENSAUDE, R., and RIVET, L. Syphilis of the Stomach. (*Presse Médicale*, Paris, Oct. 18, 1919, Vol. 27, No. 60; cited *J. Am. M. Assn.*, Vol. 73, No. 23, Dec. 6, 1919.)

Bensaude and Rivet review the manifold forms in which syphilis may manifest itself in the stomach, describing with the roentgenologic findings a number of typical cases. There are no pathognomonic symptoms, but when everything else can be excluded, syphilis can generally be accepted, as also when there is multiple localization, as in esophagus and stomach, or the skiagram is unusual. A vigorous course of arsenical treatment improves the general condition whatever the cause, as a rule, but in syphilis the local lesion shows marked improvement besides. By this twofold effect they were able to differentiate and cure the syphilis in ten recent cases. This drug test is most instructive when it has been preceded by failure of dieting and the other ordinary measures for treating stomach derangement. Iodin and mercury by the mouth are usually well borne in case of gastric syphilis, while lesions of other kinds are aggravated by them. Stenosis once installed is scarcely amenable to any medical treatment, but before this stage is reached there is no pathologic condition which yields such brilliant therapeutic successes as gastric syphilis.

MCKENNAN. Roentgen Ray Findings in Epilepsy. (*Archives of Neurology and Psychiatry*, September, 1920, iv, No. 3.)

Ninety cases were examined by McKennan. The results of the roentgen ray findings were: Tumors or evidence of pressure in the interpituitary area, 9 cases; bony deposits, 52 cases; small area, 10 cases; calcereous degeneration 2 cases; cerebropathy (this is not shown by the roentgen ray), 9 cases; no changes, 8 cases. total, 90 cases. Twenty-four cases occurred in persons over thirty-five years of age. More than 50 per cent of these cases being known to be due to an organic affection of the gland, causing it to be inefficient, would be a strong argument in itself for the conclusion that the other cases must have inefficient pituitary glands for some cause or causes. In some cases in which there was evidence of pressure in the pituitary area, McKennan has been able to have a roentgenogram made again in one or more years and has, in some instances, found that there was no progression. It would seem that if these cases are struma or other tumor growths the process of enlargement had ceased. It is possible that some of them may be simple hypertrophy. The question of pituitary feeding in epileptics, in the author's opinion, is an important one. McKennan has found that the extract of the whole pituitary gland in 2 grain doses, three times a day, and given four hours after eating, is the most satisfactory treatment. Bromids should always be used in conjunction with the pituitary extract. He is in the habit of using from 45 to 60 grains of bromid daily. After one year less bromid can be used, but the pituitary feeding must be kept up indefinitely, probably during the life of the patient.

CORDIER, VICTOR. Radiotherapy of the Malarial Spleen. (*Bulletins et Mémoires de la Société Médicale des Hôpitaux de Paris.* March 11, 1920. Page 345.)

Cordier began this work during the war, and was induced to try radiotherapy for three reasons:

(1) The necessity of obtaining a rapid and definite relief in the secondary manifestations of malaria.

(2) The need of a method to control the painful splenomegaly.

(3) The impossibility of treating with quinine those patients with malarial hemoglobinuria.

He was successful in nineteen of twenty-one cases, securing reduction in the size of the spleen, disappearance of the pain, the paroxysms, the anemia and the cachexia. These were cases which had resisted all previous treatment.

The technic used was: Three treatments, at two-day intervals, giving a dose of eight units (Bordier) with a filtration of 3 mm. of aluminum. This series was repeated every three weeks. Three series were usually required. The paroxysms returned in from three to seven months in five cases.

The red cells were increased by from 500,000 to 1,000,000 in 70 per cent of the cases; the hemoglobin percentage was increased accordingly. The white cells were not affected. The parasites were found with some difficulty during the paroxysms, they could not be found in the intervals.

His conclusions are: In radiotherapy is a method requiring some time, difficult, and in some hands, dangerous. It does not totally destroy the parasite. In rebellious cases, especially where quinine is not tolerated, it is of great service if employed skilfully.

L. S. GOIN, M.D.

CROSBIE, ARTHUR H. Diagnosis and Treatment of Tuberculosis of the Genito-Urinary Tract. (*Boston Medical & Surgical Journal,* July 29, 1920, clxxxiii, 134.)

There is nothing particularly new to bring forward in this paper. However, a résumé of the means we have to-day to arrive at an accurate diagnosis can do no harm, especially as one still sees occasionally a surgeon who when he finds acid fast bacilli in the bladder urine is content to remove the kidney on the side where he can feel a mass without further study. I know of one case where this was done and the enlarged kidney proved to be a normal hypertrophied kidney and the dead kidney was left with fatal results.

The importance of radiographs in the diagnosis of renal tuberculosis is coming more and more to be felt. To be sure, in many cases the radiograms are negative, but where there is much caseation, as where there are large abscesses filled with cheesey material, one is very apt to get suggestive shadows. I have recently seen a case where the *x*-ray helped a great deal. This was one where there were a few shadows in the cortex of the kidney which resembled stones. This represents a form of renal tuberculosis where the disease is far removed from the pelvis and where the bladder symptoms were slight and the urine negative, except for a few pus cells. I have known of two similar cases in the past where the radiographs showed shadows in the cortex resembling stones. On operation these shadows were found to be calcified areas not resembling tuberculosis. In both cases the calcified bodies were shelled out with difficulty. One developed miliary tuberculosis following the operation and the other, after having drained a long time from the incision, had the kidney removed and it was found to be tuberculous. Therefore, in cases where the radiographs show shadows in the cortex, the greatest care should be made to rule out tuberculosis, and not being able to do so, I should recommend letting such shadows alone. Pyelograms are important, of course, to make sure that shadows are in the substance of the kidney and not in a deep calyx.

Pyelograms. There is nothing distinctive in the pyelograms in tuberculosis of the kidney. The appearance does not differ materially from the pyelonephritis of some other organism. The ureter itself will at times show strictured areas, but this is not pathognomonic.

PONZIO, M. Studio radiologico dell' evoluzione dei traumatismi ossei per ferite di guerra ed indicazioni terapeutiche da esso suggerite (A Radiological Study of the Evolution of War Injuries of Bone, with the Therapeutic Indications Suggested Thereby). (*Radiol. med.*, 1919, Vol. 6, 12–25.)

Radiological examination is not merely a means of localizing foreign bodies, but its systematic use can give valuable information on the condition of damaged tissues, and so help in guiding treatment and deciding on prognosis. The author discusses at length the lessons derived from an extensive radiological experience in war wounds of bone. The main factor in these war injuries is, he considers, that there are open wounds, and nearly always infection, so that the majority do not recover in the way that is normal in simple fractures. Another difference between cases due to ordinary trauma and to projectiles of warfare, lies in their greater variety and the greater violence applied by the latter. The *x*-ray picture varies between a hardly visible crack and complete shattering of the bone; and it is hard to establish a proportional relationship between the trauma and the resulting lesion. The governing factors are the force and shape of the missile, the nature and part of bone struck, whether shaft or epiphysis, long or short bone, and whether a groove, fissure, perforation, true fracture, or shattering results.

Incomplete fracture forms.—In modern war, furrowing is rare, but can be seen in the epiphysis of large bones and on the surface of the skull and the pelvis. The sulcus has often small fissures radiating from it, but they are not easy to demonstrate in cranial and pelvic bones, though the arrangement of scattered fragments of metal will sometimes suggest their position. Isolated fissures are not common, but can be seen; when a projectile with small force strikes tangentially, it produces a linear fissure of the surface. The length of fissure depends on the nature of bone more than on the force of the blow; in long bones it may be extensive, and may also be seen at the side opposite to the point of entry. Fractures of the inner table can also be found after small wounds of the head, and explain persistence of symptoms out of proportion to what was expected from clinical examination.

Perforation is rarely seen in simple form. It may be incomplete, and contain a firmly embedded fragment of shell or grenade; more commonly one sees a hole surrounded by radiating fissures, especially at the point of exit.

The course of these incomplete bone lesions is usually good, but much after-trouble may result from laceration of periosteum, leading to the formation of adhesions or bony enlargement, especially when near joints and after infection. The process of bone repair may be retarded by the presence of a foreign body, or by the establishment of localizing osteitiis or osteomyelitis. Radiograms show that such process is limited to the region of the wound, and seldom spreads. Repair is slow, and solution of bony continuity can be seen for a long time. Perforation leaves little after-trouble, unless it involves joint surfaces or is complicated by injury to other organs. The former may end with decalcification, rarefaction, ankylosis, which can only be appreciated fully by the *x*-ray picture.

Complete fracture is the more common form of bone injury, and is mostly complicated and comminuted, owing to the great force of modern projectiles. *X*-rays show in most cases, especially in wounds sustained at close quarters, extensive and minute shattering of the bones, characteristic of an explosive type of violence, with dissemination of bony and metallic fragments in the soft parts around. One has wrongly attributed to "explosive bullets" these results, which are really due to the explosive effect of modern high velocity projectiles at short range. This is proved by examination of captured Austrians and of cases of accidental wounds, which show appearances of an equally explosive type where the use of explosive bullets can be excluded.

The author insists on the necessity of periodical *x*-ray examination as the surest means of establishing the nature of the condition present at each stage, and the desirability and extent of operation when indicated. He denounces excessive or hasty removal of bony fragments as a frequent cause of useless and flail joints and bony deformities from deficiency of substance. The patients are young, fit, and of full cellular activity; the bone fragments show vigorous efforts at growth, ejecting useless pieces and binding the rest in callus. The growth may even be excessive, and produce obliteration of interosseus spaces, infiltration of muscle, obstruction at joints, and compression of nerves or vessels. These conditions can be elucidated by radiology alone.

Systematic *x*-ray examination has thrown much light on the nature of calculus and its formation, and on the treatment of pseudarthrosis and delayed and mal-union of fractures. It is more common to find lack of con-

solidation of callus than complete absence of new bony growth. Differentiation between fibrous union and false joint is not always easy, as the radiograph does not always agree with the clinical picture. True pseudarthrosis is relatively rare in war surgery.

The process of osteitis goes on in the superficial layers of the bone and spreads, while a reactive and defensive area appears more deeply in the form of compact bone showing no trabecular structure to *x*-rays. This limits the infective process, but may later on be an obstacle to closure of cavities. If suppuration lasts long, the osseous reactive tissue is less distinct, the zone of osteitis more extensive, and calcareous osteo-atrophy becomes evident. The healing of the wound is too often taken as a sign that observation may cease, and bad functional results ensue. These can be prevented by proper *x*-ray supervision, which will reveal conditions likely to benefit by physical treatment or by surgery, or by avoidance of forcible manipulation where a quiescent focus may be lighted up. In a comparison of many cases the most remarkable functional results were seen when there was a combination of surgical treatment with prolonged and systematic physiotherapy. Among points for consideration here the author says that pain in stumps is less commonly due to neuroma than to neuritis of compression, ischemia or distrophy of callus, bony spicules, etc., and seldom to foreign bodies. Pain in joints is often due to osteo-atrophy, which *x*-rays show may follow even slight injury with prolonged fixation. The consolidation of callus is not the final stage, bony deformity may progress, and local weakness may exist, so these cases should be watched for a very long time.

Fixation by metal wires or screws or bone-grafts should only be done when deformity is excessive, and then only when sepsis is quite gone. When a graft is succeeding its substance can be seen to be invaded by new bone, in less favorable cases it is quickly isolated by a fibrous wrapping and is left useless.

Non-union is now seldom seen, owing to improved technique, of which *x*-ray control is an important part. In all this work the radiological contribution needs constant and minute attention, anatomical and pathological knowledge, and cannot be efficiently done by nurses, orderlies, or other subordinates.

N. H. M. B.

INDEX TO VOLUME VII

ABSTRACTS:

Bainbridge, William Seaman, A study of certain bands in the right upper abdominal quadrant, 321.

Barber, William Howard, Gastric hypermotility associated with gall-bladder disease, 170.

Beck, Harvey G., Comparative study of gastric motility by test meal and barium retention, 574.

Bensaude and Rivet, Syphilis of the stomach, 620.

Braasch, W. F., Renal fluoroscopy at the operating table, 369.

Carman, R. D., Renal fluoroscopy at the operating table, 369.

The operability of cancer of the stomach as determined by the roentgen ray, 122.

Carrera, Jose Luis, A pathological study of the lungs in 152 cases of syphilis, 416.

Chambers, H., Experimental studies with small doses of *x*-rays, 120.

Cofield, Robert B., Some difficulties in the diagnosis of osteosarcoma, 618.

Cohn, Alfred E., An investigation of the size of the heart in soldiers by the teleroentgen method, 368.

Collin, E., Radiotherapy in Sweden, 619.

Cordier, Victor, Radiotherapy of the malarial spleen, 622.

Cramer, I. H., Roentgenological determination of pulmonary tuberculosis, 273.

Crosbie, Arthur H., Diagnosis and treatment of tuberculosis of the genito-urinary tract, 622.

Crouse, Hugh, Chronic duodenal dilatation, its concomitant and sequential pathology, 322.

Dandy, Walter E., Localization of elimination of cerebral tumors by ventriculography, 466.

De Niord, Hollis H., and Richard N., Effect of roentgen rays on the metabolism of cancer patients, 520.

Diemer, F. E., Roentgenological determination of pulmonary tuberculosis, 273.

Dimier et Bergonie, Guinea worm revealed by *x*-rays, 276.

Elding, A very rare case of non-malignant tumor of the lungs, 323.

Espinola, Rafael, Radiotherapy in surgical tuberculosis of children, 275.

Evans, John, Comparative study of gastric motility, 574.

Firmin-Cuthbert, Case of appendix containing 36 shot, followed by signs of malignant endocarditis, 419.

Frank, Louis, Congenital diaphragmatic hernia, 469.

Fussell, M. H., A roentgen ray sign of perinephritis abscess, 174.

Gage, Harold C., Radiographs direct on bromide paper and their place in war economy, 121.

George, Arial W., A method for more accurate study of injuries to the atlas and axis, 319.

Gewin, Wm. C., Use of radium in treatment of metrorrhagia and menorrhagia, 518.

Honeij, James A., Cavity formation and annular pleural shadows in pulmonary tuberculosis, 463.

Iser, Solomon, The roentgen diagnosis of subphrenic abscess, 465.

Janeway, Henry H., The treatment of malignant tumors of the thymus gland by radium, 419.

Japiot, Fracture of scaphoid without displacement, 324.

Abstracts—*Continued*

Jordan, Arthur, Eighteen months' experience with radium, 173.

Judd, E. S., The results of surgical treatment of exophthalmic goiter, 573.

Kaye, G. W. C., Examination of air craft timber by *x*-rays, 321.

Kelly, Howard A., Radium therapy, 177.

Key und Akerlund, Calcified aneurysm of the renal artery, 276.

Knox, Robert, Examination of liver, gall-bladder and bile ducts, 178.

Knox, R., The examination of air craft timber by *x*-rays, 321.

Knudson,, Arthur, Metabolism in leukemia and cancer during radium treatment, 321.

Lagarenne and Guilleminot, Pharyngo-esophageal diverticula, or pulsion diverticula of Zenker, 470.

Langmead, Notes of a case of esophagectasis in an infant, with radiograms, 522.

McKennan, Roentgen ray findings in epilepsy, 620.

Meyer, William H., Roentgen therapy in gynecology, 177.

Mitchell, William, Splenic calculi, 123.

Molyneux, Echlin S., Radium in the treatment of tuberculous adenitis, 124.

Mottram, J. C., Experimental studies with small doses of *x*-rays, 120.

Neill, William, Jr., Radium therapy, 177.

Ordway, Thomas, Metabolism in leukemia and cancer during radium treatment, 321.

Orndorff, B. H., Pneumoperitoneum in *x*-ray diagnosis, 173.

Pancoast, Henry K., A roentgen ray sign of perinephritic abscess, 174.

Roentgen ray studies of the functional alterations of the diaphragm, 322.

Petit de la Villeon, The extraction of intrathoracic projectiles, 227.

Phemister, D B., The recognition of dead bone based on pathological and *x*-ray studies, 571

Pickerel, Extensive lesions of anthracosis and pneumoconiosis with absence of physical signs, 522.

Pirie, A. Howard, The present status of radiotherapy, 171.

Ponzio, M., A radiological study of the evolution of war injuries of bone, 623.

Prime, Frederic, Lethal dose of roentgen rays for cancer cells, 170.

Ransohoff, J. Louis, Late results in the radium treatment of cancer of the uterus, 223.

Riggs, Theodore F., Diaphragmatic hernia, 369.

Roberts, Dudley, Certain limitations of roentgen ray diagnosis of gastro-intestinal diseases, 175.

Russ, S., Experimental studies with small doses of *x*-rays, 120.

Schanz, Robert F., Iodid and bromid pastes as used in roentgenography, 174.

Schreiner, Bernard F., Effect of roentgen rays on metabolism of cancer, 520.

Schwarz, Contrast-meal calculi after *x*-ray investigation of large intestine, 324.

Scott, Gladwys M., Experimental studies with small doses of *x*-rays, 120.

Simmons, Channing C., the treatment of carcinoma of the skin with radium. Results of cases

Abstracts—*Continued*
treated at the Collis P. Huntington Memorial Hospital, 64.
Slesinger, E. G., Osteitis fibrosa, 65.
Stewart, George David, Gastric hypermotility associated with gall-bladder disease, 170.
Subbel, Hydatid cyst of the lung discovered by radiography, 574.
Tait, Jean, Metabolism in leukemia and cancer during radium treatment, 321.
Thompson, Harold B., Osteomyelitis and its classification radiographically, 322.
Tyler, A. F., Syphilis of the great vessels, 176.
Vaccarezza, Raul F., Las intoxicaciones por el subnitrato de bismuto, 227.
Wilkins, H. F., The use of radium in the treatment of metrorrhagia and menorrhagia, 518.
Wise, Fred, Roentgen ray treatment of widespread and generalized diseases of the skin, 521.
Wood, Francis Carter, Lethal dose of roentgen rays for cancer cells, 170.
Adeno-carcinoma of the stomach, 602.
Action of Buried Tubes of Radium Emanation upon Normal and Neoplastic Tissues, Halsey J. Bagg, 536.
Aikins, W. H. B., Radium in toxic goiter, 404.
Air craft timber examined by *x*-rays, Abstract, 321.
Alveolar Infections of Dental Origin as Seen by the Roentgenologist, H. W. Dachtler, 302.
Aneurysm, Calcified, of the renal artery, Abstract, 276.
Aneurysms, thoracic, 90.
Angiomata, Treatment with radium, 337.
Annular pleural shadows in pulmonary tuberculosis, Abstract, 463.
Anomalous Relation of Roentgenology to Medical Practice, W. Warner Watkins, 531.
Anthracosis and pneumoconiosis, extensive lesions of, Abstract, 522.
Appendix containing 36 shots, Abstract, 419.
Artificial penumo-peritoneum, duration of, 502.
Ashbury, Helen, X-Ray (poem).
Aviators' Heart, Roentgen Ray Studies under Conditions Simulating High Altitudes, Leon T. Le Wald and Guy H. Turrell, 67.

Bagg, Halsey J., The action of buried tubes of radium emanation upon normal and neoplastic tissues, 536.
Bands in the right upper abdominal quadrant, A study of, Abstract, 321.
Béclère, A., The radiotherapy of uterine fibromyomata. Results, mode of action and indications, based on the study of 400 personal observations, 30.
Belden, Webster W., Hernia of the diaphragm with a portion of the stomach in the thoracic cavity, 250.
Biological Reaction of Carcinoma Cells Produced by Radium Rays. The Technique of Radium Therapy in Gynecology, Henry Schmitz, 52.
Bissell, Frank S., The Heart Symposium, Editorial, 62.
Boggs, Russell H., Lethal and erythema dosage of radium in malignancy, 398.
Radium in the treatment of carcinoma of the cervix and uterus, 202.
Bonney, T. C., Congenital absence of middle joint of little finger, 336.
Bony Changes in the Feet Following Fractures of the Vertebrae, Lloyd Bryan, 125.

Book Reviews:
Los Rayos X en el Diagnostico de las Enfermedades del Estomago, Doctors José Gonzalez Campo and José Gonzalez-Campo de Cos., James T. Case, 63.
Medical Clinics of North America, Chicago number, 218.
Bowen, Charles F., Fractures of the bones of the face, 350.
Bowen developing tank, Useful attachment to, 345.
Bowing, H. H., Topical applications of radium, 582.
Braasch, W. F., Roentgen examination of the urinary tract made opaque, 584.
Brown, Lawrason, The occurrence of intestinal tuberculosis in patients with pulmonary tuberculosis at the Trudeau Sanatorium, 395.
Bryan, Lloyd, Bony changes in the feet following fracture of the vertebrae, 125.
Secondary hypertrophic osteo-arthropathy with metastatic sarcoma of the lung, 286.
Bucky Diaphragm Principle Applied to Roentgenography, Hollis E. Potter, 292.
I. Seth Hirsch, Editorial, 617.
Buried emanation, its use in treating malignant tumors, 325.
Tubes of radium emanation, their action on normal and neoplastic tissues, 536.
Butler, P. F., Cardiospasm, 478.

Calculi, Contrast-meal, after *x*-ray investigation of large intestine, Abstract, 324.
Canadian Expeditionary Force, *X*-Ray work in, 26.
Cancer Ameliorations and Cancer Immunity, A. F. Holding, 306.
Of the stomach, its operability as determined by the roentgen ray, R. D. Carman, Abstract, 122.
Of the uterus, late results of radium treatment, Abstract, 223.
Radium in, 42.
The roentgen ray in, 146.
Of tongue, tonsil and rectum, Treatment by buried emanation, 92.
Carcinoma cells, Biological reaction produced by radium rays, 52.
Of the Breast, Douglas Quick, 597.
Treatment of recurrences and metastases by radium and roentgen rays, 328.
Of the cervix and uterus, Radium in treatment of, 202.
Of the skin, Treatment with radium, Channing C. Simmons, Abstract, 64.
Radiation in inoperable cases in the female genito-urinary organs, 36.
Cardiospasm, P. F. Butler, 478.
Carman, R. D., Roentgenology in the Mayo Clinic, 577.
Case, James T., Death of Dr. Jaugeas, Editorial, 167.
Case of Infantile Scurvy, William Augustus Newell, 371.
Of Pedunculated Adeno-Carcinoma of the Stomach and Possible Errors in Diagnosis, Eugene P. Pendergrass and Henry K. Pancoast, 602.
Of Xanthoma Showing Multiple Bone Lesions, A. S. Merrill, 480.
Showing Value of the *X*-Ray in Urological Diagnosis, G. Frank Lydston, 403.
Cataracts, The technic of radium application in, 107.
Cavity formation and annular pleural shadows in pulmonary tuberculosis, Abstract, 463.
Cerebral tumors, their localization or elimination by ventriculography, Abstract, 466.
Cervix and Uterus, Radium in treatment of carcinoma of, 202.

Chronic Gastric Ulcer and Gastric Carcinoma, William Carpenter MacCarty, 591.
Cirrhosis of the liver, diagnosed by the help of *x*-rays, 296.
Clark, John G., Radiation in inoperable cases of carcinoma in the female genito-urinary organs, 36.
Classification of Uterine Carcinoma for the Study of the Efficacy of Radium, Henry Schmitz, 383.
Clift, M. William, Fluoroscopic examination in injuries to the head, 137.
Combination of Roentgen Rays and Radium in Uterine Carcinoma, E. H. Skinner, 376.
Congenital (Hereditary) Absence of Middle Joint of Little Finger, T. C. Bonney, 336.
Coolidge, W. D., Oil-immersed *x*-ray generating outfits, 181.
Coolidge *x*-ray tubes, their manufacture, 254.
Crane, A. W., Dr. Mills's Address, Editorial, 568.

Dachtler, H. W., Alveolar infections of dental origin as seen by the roentgenologist, 302.
Dangers, Electrical, in *x*-ray laboratories, 432.
In the *x*-ray room, Editorial, 168.
Dead bone, its recognition based on pathological and *x*-ray studies, Abstract, 571.
Diagnosis and Localization of Non-opaque Foreign Bodies in the Bronchi, Chevalier Jackson, William H. Spencer and Willis F. Manges, 277.
And treatment of tuberculosis of the genito-urinary tract, Abstract, 622.
By the Help of *X*-Rays of Cirrhosis of the Liver, A. Howard Pirie, 296.
Diaphragmatic Hernia, Alexander Stewart MacMillan, 143.
Theodore F. Riggs, Abstract, 369.
Without Severe Symptoms, A Case of, Discovered on Routine *X*-Ray Examinations of Chest, Horace John Howk and John A. Herring, 247.
Digestive tract, Pathological findings in 1,000 roentgen ray examinations, 234.
Disc Attachment for Victor Serial Timer, Harold B. Thompson, 459.
Discussion of Drs. Janeway's and Pfahler's articles, 333.
Of papers by Drs. Clark, Keene, Samuels and Schmitz, 57.
Diverticulitis of the colon, Value of roentgen ray in studying, 421, 505.
Dosage, *x*-ray, Unfiltered and filtered, 485.
Duodenal dilatation, Chronic, Abstract, 322.

Eastmond, Charles, Report of a case of osteosarcoma of the tibia, 460.
Editorials:
Advantages of Group Medicine to Roentgenologists, 615.
CO_2 Instead of O_2 for Injecting the Peritoneal Cavity, Alvarez, 220.
Correspondence: Fearn, J. B., Shanghai, 363.
Hirsch, I. Seth, and Manges, W. F., 414.
Iglauer, Samuel, and Manges, W. F., 413.
Mills, R. Walter, and Ansell, P L., 318.
Dangers in the *X*-Ray Room, 168.
Death of Dr. F. Jaugeas, James T. Case, 167.
Dr. Mills's Address, A. W. Crane, 568.
Epigram, 569.
Harris, Herschel, Obituary Notice, 517.
Heart Symposium, Frank S. Bissell, 62.
Inter-Allied Roentgenological Club, 119.
Lee, Dr. John A., Obituary, John G. Williams, 271.
Leonard Prize for Research, 567.
Editorials—*Continued*
Meetings:
American Association of Military Roentgenologists, organization, 569.
American Electrotherapeutic Society, thirtieth annual meeting, 517.
American Radium Society, fifth annual meeting, 362.
Committee on Revision of the Constitution A. R. R. S., 570.
Eastern Section American Roentgen Ray Society, first annual meeting, 166.
Second annual meeting, notice of, 516.
Middle Section American Roentgen Ray Society, 219, 618.
Notice to Western Roentgenologists, 169.
Omaha Roentgen Ray Society, annual meeting, 272.
Radiological Society of North America, annual meeting, 618.
Southern Medical Association, first meeting of section in roentgenology, 516.
Organization of roentgenological section in, 118.
Twenty-first Annual Meeting American Roentgen Ray Society, First announcement, 62; Minneapolis, 310; Outline of program, 316; Further suggestions about trip, 358; Preliminary program, 360; Last call for Minneapolis, 412; Special plans for entertainment of ladies, 412; Proceedings, 513.
Western Electro-Therapeutic Association, annual meeting, 272.
Western section of the American Roentgen Ray Society, first annual meeting, 318.
Radium Research Committee Schedule, 462.
Secher, Dr. Med. K., Communication, 364.
Effect of Different Filters on Radium Radiations, Edith H. Quimby, 492.
Ejaculatory ducts, injected with thorium, *X*-Ray studies, 16.
Electrical Dangers in *X*-Ray Laboratories, J. S. Shearer, 432.
Enlarged thymus glands in infants, Radium treatment of, 191.
Epilepsy, Roentgen ray findings in, Abstract, 620.
Esophagectasis in an infant, Abstract, 522.
Examination of air craft timber by *x*-rays, Abstract, 321.
Of liver, gall-bladder and bile ducts, Abstract, 178.
Exophthalmic goiter, Results of surgical treatment, Abstract, 573.
Experimental Study of the Duration of Artificial Pneumo-Peritoneum, Leon T. LeWald, 502.
Extraction of intrathoracic projectiles, Abstract, 227.
Eyster, J. A. E. Instantaneous radiographs of the human heart at determined points in the cardiac circle, 471.

Face, Fractures of bones of, 350.
Feet, Bony changes in, following fracture of the vertebrae, 125.
Fibromata and uterine hemorrhages, treatment by *x*-rays, 544.
Films and plates for use in roentgenology, their manufacture, 131
Filtered and unfiltered *x*-ray dosage, 485.
Filters, Effect of different, on radium radiations, 492.
Fluoroscope, A plea for the use of, in examination of heart and great vessels, 1.
Fluoroscopic Examination in Injuries to the Head, M. William Clift, 137.

Foreign body, A traveling, 327.
Fractures of the Bones of the Face, Charles F. Bowen, 350.
Functional alterations of the diaphragm, Roentgen ray studies of, Abstract, 322.
Further Comments on Radio-Activity, Albert Soiland, 102.

Gardner, Boyd S., Roentgenology in diseases of the teeth, 587.
Gas-containing roentgen ray tubes with description of a new tube, 261.
Gastric and duodenal ulceration, Abstract, 221.
Relation to cancer, Abstract, 222.
Carcinoma, Chronic gastric ulcer and, 591.
Hypermotility associated with gall-bladder disease, Abstract, 170.
Motility, studied by test meal and barium retention, Abstract, 574.
Polyp, Unusual, 356.
Spasm and *x*-ray examinations, Abstract, 221.
Gastro-enterology, The relation of roentgenology to clinical medicine with reference to, 523.
Gastro-intestinal diseases, certain limitations of roentgen ray diagnosis, Abstract, 175.
George, Arial W., The value of the roentgen ray in the study of diverticulitis of the colon, 421, 505.
Glass in the Hand, A. R. Taft, 461.
Goin, Lowell S., Malignant abdominal tumor clinically cured by *x*-rays, 297.
Personal experience in military roentgenology over-seas, 128.
Goiter, Radium in toxic, 404.
Graduate Education in Roentgenology, Louis B. Wilson, 580.
Guinea-worm revealed by *x*-rays, Abstract, 276.
Gynecology, Roentgen therapy in, Abstract, 177.

Harkavy, Joseph, Influenza pneumonia from a clinical and *x*-ray study, 109, 148.
Head, injuries to, Fluoroscopic examination, 137.
Heart, human, Instantaneous radiographs of, 471.
Symposium, Editorial, Frank S. Bissell, 62.
The aviators', 67.
Heck, Stanton, A stereofluoroscope, 448.
Heise, F. H., The occurrence of intestinal tuberculosis in patients with pulmonary tuberculosis at the Trudeau Sanatorium, 395.
Henderson, M. S., Osteocartilaginous joint bodies, 588.
Hernia of the Diaphragm with a Portion of the Stomach in the Thoracic Cavity, Webster W. Belden, 250.
Congenital diaphragmatic, Abstract, 469.
Diaphragmatic, 143.
True congenital, in the right diaphragm, 289.
Herring, John A., A case of diaphragmatic hernia without severe symptoms discovered on routine *x*-ray examination of chest, 247.
Heublein Arthur C., Radium treatment of enlarged thymus glands in infants, 191.
Hirsch, I. Seth, Bucky diaphragm, Editorial, 617.
Hodges, Paul C., A stereoscopic tube stand particularly adapted for the examination of the skull, 564.
Hodgson, Millard B., The manufacture of films and plates for use in roentgenology, 131.
Holding, A. F., Cancer ameliorations and cancer immunity, 306.
Holmes, George W., The radiographic findings in pericarditis with effusion, 7.
Howk, Horace John, A case of diaphragmatic hernia without severe symptoms discovered on routine *x*-ray examination of chest, 247.
Hubeny, Maximilian John, Roentgen diagnosis of patent ductus arteriosus with report of a case complicated by presence of saccular aneurysm, 23.
Hydatid cyst of the lung, Abstract, 574.
Hypertrophic osteo-arthropathy, with metastatic sarcoma of the lung, 286.

Infantile scurvy, A case of, 371.
Influenza Pneumonia from a Clinical and *X*-Ray Study, Joseph Harkavy and John Hunter Selby, 109, 148.
Injecting peritoneal cavity with CO_2 instead of O_2, Alvarez, Editorial, 220.
Injuries to the atlas and axis, A method for more accurate study, Abstract, 319.
Instantaneous Radiographs of the Human Heart at Determined Points in the Cardiac Circle, J. A. E. Eyster and Walter J. Meek, 471.
Intensifying screens, A new method of mounting, 446.
Tests of *x*-ray, 196.
Intestinal tuberculosis combined with pulmonary tuberculosis at the Trudeau Sanatorium, 395.
Intoxicaciones por el subnitrato de bismuto, Abstract, 227.
Iodid and bromid pastes as used in roentgenography, Abstract, 174.

Jackson, Chevalier, The diagnosis and localization of non-opaque foreign bodies in the bronchi, 277.
Janeway, Henry H., The treatment of cancer, particularly of the tongue, tonsil and rectum, by buried emanation, 92.
The use of buried emanation in the treatment of malignant tumors, 325.
Jaugeas, Dr. F., Death of, Editorial, 167.
Jewett, E. Harvey, Teleroentgenology of the sella turcica with observations on 100 normal cases, 352.

Keene, Floyd E., Radiation in inoperable cases of cancer in the female genito-urinary organs, 36.
Keith, D. Y., A true congenital hernia in the right diaphragm, 289.
Koenig, E. C., A traveling foreign body, 327.

Legg's disease, four cases, 347.
Leonard, Ralph D., The value of the roentgen ray in the study of diverticulitis of the colon, 421, 505.
Lethal and Erythema Dosage of Radium in Malignancy, Russell H. Boggs, 398.
Dose of roentgen rays for cancer cells, Abstract, 170.
Leukemia, Notes on the roentgen treatment of, 608.
Levin, Isaac, Rationale of radium therapy in cancer, 552.
The technic of radium application in cataracts, 107.
LeWald, Leon T., The aviators' heart. Roentgen rays under conditions simulating high altitudes, 67.
An experimental study of the duration of artificial pneumo-peritoneum, 502.
Liability of roentgenologist, Medico-legal, Abstract, 572.
Liver, gall-bladder and bile ducts, Examination of, Abstract, 178.
Lydston, G. Frank, Case showing value of the *x*-ray in urological diagnosis, 403.

MacCarty, William Carpenter, Chronic gastric ulcer and gastric carcinoma, 591.
MacMillan, Alexander Stewart, Diaphragmatic hernia, 143.
McCarty, E. D., *X*-Ray studies in gout, 451.
Malignant Abdominal Tumor Clinically Cured by *X*-Ray, Lowell S. Goin, 297.
Disease successfully treated by roentgen therapy, 231.
Within the abdomen, Roentgenotherapy in, 210.
Tumors of the thymus gland treated by radium, Abstract, 419.
Use of buried emanation in treatment of, 325.
Manges, Willis F., The diagnosis and localization of non-opaque foreign bodies in the bronchi, 277.
Manufacture of Films and Plates for Use in Roentgenology, Millard B. Hodgson, 131.
Of the Coolidge *X*-Ray Tubes, R. C. Robinson and C. N. Moore, 254.
Matas, Rudolph, Radium therapy, 440.
Mayo, Charles H. Address of Welcome, 576.
Mayo Clinic, Roentgenology in, 577.
Mayo, William J., Address of Welcome, 575.
Medico-Legal: Circumstantial authentication of roentgenogram when lost, Abstract, 619.
Liability of roentgenologist, 572.
Meek, Walter J., Instantaneous radiographs of the human heart at determined points in the cardiac circle, 471.
Menorrhagia, Radium treatment in 600 cases, 379.
And metrorrhagia, radium used in treatment of, Abstract, 518.
Merrill, A. S., Case of xanthoma showing multiple bone lesions, 480.
Metabolism in leukemia and cancer during radium treatment, Abstract, 321.
Of cancer patients, Effect of roentgen rays on, Abstract, 520.
Military roentgenology overseas, 128.
Mills, Walter R., The relation of roentgenology to clinical medicine with special reference to gastro-enterology, 523.
Minneapolis, 310.
Model *x*-ray laboratory, Plan of, 298.
Moore, C. N., Manufacture of the Coolidge *x*-ray tubes, 254.
Morgan, J. D., Plan of a building for a model *x*-ray laboratory, 298.
Morrison, Robert T., A new method of mounting intensifying screens, 446.
Mounting intensifying screens, A new method, 446.
Multiple bone lesions, Case of xanthoma showing, 480.
Mutscheller, A., A study of gas-containing roentgen ray tubes and a description of a new tube, 261.

Newcomet, William S., Treatment of angiomata with radium, 337.
Newell, William Augustus, A case of infantile scurvy, 371.
New Method, A, of Mounting Intensifying Screens, Robert T. Morrison, 446.
Non-malignant tumor of the lungs, Abstract, 323.
Non-opaque foreign bodies in the bronchi, their diagnosis and localization, 277.
Notes on the Roentgen Treatment of Leukemia, With Report of a Case Under Treatment for Four Years, W. O. Upson, 608.

Occurrence of Intestinal Tuberculosis in Patients with Pulmonary Tuberculosis at the Trudeau Sanatorium, Lawrason Brown, Homer L. Sampson and F. H. Heise, 395.
Oil-Immersed *X*-Ray Generating Outfits, W. D. Coolidge, 181.
Osteitis Fibrosa, E. G. Slesinger, Abstract, 65.
Osteocartilaginous Joint Bodies, M. S. Henderson, 588.
Osteochondral Trophopathy of the Hip-Joint. Legg's Disease. Report of Four Cases, W. E. Reiley, 347.
Osteomyelitis and its classification radiographically, Abstract, 322.
Osteosarcoma of the tibia, Report of a case, 460.
Some difficulties in the diagnosis of, Abstract, 618.

Pancoast, Henry K., A case of pedunculated adenocarcinoma of the stomach and possible errors in diagnosis, 602.
The roentgen ray in cancer of the uterus, 146.
Panneton, J. E., The *x*-rays in the treatment of fibromata and uterine hemorrhages, 514.
Patent ductus arteriosus with saccular aneurysm, 23.
Pathological Findings in 1,000 Roentgen Ray Examinations of the Digestive Tract, W. Warner Watkins, 234.
Pedunculated adeno-carcinoma of the stomach, 602.
Pendergrass, Eugene P., A case of pedunculated adeno-carcinoma of the stomach and possible errors in diagnosis, 602.
Pericarditis with effusion, Radiographic findings in, 7.
Perinephritic abscess, A roentgen ray sign of, Abstract, 174.
Peritoneal tuberculosis, latent, *X*-Ray diagnosis, Abstract, 221.
Personal Experience in Military Roentgenology Over-Seas, Lowell S. Goin, 128.
Pfahler, George E., Roentgenotherapy in malignant disease within the abdomen, with reports upon thirteen cases, 210.
Spring clip for holding *x*-ray films on the illumination box, 614.
Treatment of recurrences and metastases from carcinoma of the breast by means of radium and roentgen rays, 328.
Pharyngo-esophageal diverticula, or pulsion diverticula of Zeuker, Abstract, 470.
Pirie, A. Howard, Diagnosis by the help of *x*-rays of cirrhosis of the liver, 206.
Plan of a Building for a Model *X*-Ray Laboratory, J. D. Morgan, 298.
Plea for the Use of the Fluoroscope in the Examination of the Heart and Great Vessels, James G. Van Zwaluwenburg, 1.
Pneumo-peritoneum, duration of artificial, 502.
In *x*-ray diagnosis, B. H. Orndorff. Abstract, 173.
Potter, Hollis E., The Bucky diaphragm principle applied to roentgenography, 292.
Pre-Operative and Postoperative *X*-Ray in Carcinoma of the Breast, Douglas Quick, 597.
Prize, Leonard, for Research, Editorial, 567.
Pruritis ani, Treatment by *x*-ray radiation, 116.
Pulmonary tuberculosis, Roentgenological determination of, Abstract, 273.

Quick, Douglas, Pre-operative and post-operative *x*-ray in carcinoma of the breast, 597.
Quimby, A. Judson, Useful attachment to a Bowen developing tank, 345.
Quimby, Edith H., Effect of different filters on radium radiations, 492.

Radiation in Inoperable Cases of Carcinoma in the Female Genito-Urinary Organs, John G. Clark and Floyd E. Keene, 36.
Radio-Activity, Further comments on, 102.

Radiographic Findings in Pericarditis with Effusion, George W. Holmes, 7.
Radiographs direct on bromide paper and their place in war economy, Abstract, 121.
Instantaneous, of the human heart, 471.
Radiotherapy in surgical tuberculosis of children, Abstract, 275.
In Sweden, Abstract, 619.
Its present status, Abstract, 171.
Of the malarial spleen, Abstract, 622.
Of Uterine Fibromyomata. Results, Modeof Action and Indications, Based on the Study of 400 Personal Observations, A. Béclère, 30.
Radium application in cataracts, 107.
Eighteen months' experience with, Abstract, 173.
Element versus Emanation, Albert Soiland, 612.
Emanation, Action of buried tubes on normal and neoplastic tissue, 536.
In malignancy, Lethal and erythema dosage, 398.
In the Treatment of Carcinoma of the Cervix and Uterus, Russell H. Boggs, 202.
In the treatment of tuberculous adenitis, Abstract, 124.
In Toxic Goiter, W. H. B. Aikins, 404.
Radiations, Effect of different filters on, 492.
Therapy, Rudolph Matas, 440.
Therapy, Abstract, 177.
In cancer, its rationale, 552.
In gynecology, Abstract, 177.
Its efficacy in different classes of uterine carcinoma, 383.
Technique of, in gynecology, 52.
Topical applications of, 582.
Treatment in 600 Cases of Menorrhagia, Leda J. Stacy, 379.
Of cancer of the uterus, Late results, Abstract, 223.
Of Enlarged Thymus Glands in Infants, Arthur C. Heublein, 191.
Use of, in treatment of metrorrhagia and menorrhagia, Abstract, 518.
Rationale of Radiumtherapy in Cancer, Isaac Levin, 552.
Recognition of dead bone based on pathological and *x*-ray studies, Abstract, 571.
Reiley, W. E., Osteochondral trophopathy of the hip-joint, Legg's Disease, 347.
Relation of Roentgenology to Clinical Medicine with Special Reference to Gastro-Enterology, R. Walter Mills, 523.
Remer, John, Unfiltered and filtered *x*-ray dosage, 485.
Renal fluoroscopy at the operating table, Abstract, 369.
Report of a Case of Osteo-Sarcoma of the Tibia, Charles Eastmond, 460.
A Case of Thyroid Metabolism, C. W. Schwartz, 229.
Four Cases of Malignant Disease Successfully Treated by Roentgen Therapy, A. F. Tyler, 231.
Some Interesting Thoracic Aneurysms, A. Robert Taft, 90.
Robinson, R. C., Manufacture of the Coolidge *x*-ray tubes, 254.
Roentgen Diagnosis of Patent Ductus Arteriosus with Report of a Case Complicated by Presence of Saccular Aneurysm, Maximilian John Hubeny, 23.
Of subphrenic abscess, Abstract, 465.
Examination of the Urinary Tract Made Opaque, W. F. Braasch, 584.
Roentgenological determination of pulmonary tuberculosis, Abstract, 273.
Roentgenology and clinical medicine, their relation, 523.
And medical practice, their anomalous relation, 531.
In Diseases of the Teeth, Boyd S. Gardner, 587.
In the Mayo Clinic, R. D. Carman, 577.
Roentgen Ray in Cancer of the Uterus, Henry K. Pancoast, 146.
Treatment of widespread and generalized diseases of the skin, Abstract, 521.
Therapeutist, A word to the, 357.
Roentgenotherapy in Malignant Disease within the Abdomen with Reports upon Thirteen Cases, George E. Pfahler, 210.
Roentgen therapy in treatment of malignant disease, 231.
Ruggles, Howard E., Unusual gastric polyp, 356.

Saccular aneurysm in patent ductus arteriosus, 23.
Sampson, Homer L., The occurrence of intestinal tuberculosis in patients with pulmonary tuberculosis at the Trudeau Sanatorium, 395.
Samuels, Ernest Charles, Three years' experience with radium in cancer of the uterus, 42.
Scaphoid, Fracture without displacement, Abstract, 324.
Schmitz, Henry, The biological reaction of carcinoma cells produced by radium rays. The technique of radium therapy in gynecology, 52.
The classification of uterine carcinoma for the study of the efficacy of radium therapy, 383.
Schwartz, C. W., Report of a case of thyroid metabolism, 229.
Secondary Hypertrophic Osteo-Arthropathy with Metastatic Sarcoma of the Lung, Lloyd Bryan, 286.
Selby, John Hunter, Influenza pneumonia, from a clinical and *x*-ray study, 109, 148.
Sella turcica, Teleroentgenology of, 352.
Seminal vesicles and vasa deferentia after injection of ejaculatory ducts with thorium, 16.
Shearer, J. S., Electrical dangers in *x*-ray laboratories, 432.
Simpson, C. Augustus, A word to the roentgen therapeutist, 357.
Skin diseases, widespread and generalized, Roentgen ray treatment, Abstract, 521.
Skinner, Edward H., The combination of roentgen rays and radium in uterine carcinoma, 376.
Small doses of *x*-rays, Experimental studies with, Abstract, 120.
Soiland, Albert, Further comments on radio-activity, 102.
Radium element versus emanation, 612.
Spencer, William H., The diagnosis and localization of non-opaque foreign bodies in the bronchi, 277.
Spleen, malarial, Radiotherapy of, Abstract, 622.
Spring Clip for Holding *X*-Ray Films on the Illumination Box, George E. Pfahler, 614.
Splenic calculi, Abstract, 123.
Stacy, Leda J., Radium treatment in 600 cases of menorrhagia, 379.
Radium Research Committee Schedule, Editorial, 462.
Stereofluoroscope, A, Stanton Heck, 448.
Stereoscopic Tube Stand Particularly Adapted for the Examination of the Skull, Paul C. Hodges, 564.

Study of Gas-Containing Roentgen Ray Tubes and a Description of a New Tube, A. Mutscheller, 261.
Subphrenic abscess, Roentgen diagnosis of, Abstract, 465.
Syphilis, A pathological study of the lungs in 152 cases, Abstract, 416.
Of the great vessels, Abstract, 176.
Of the stomach, Abstract, 620.

Taft, A. Robert, Glass in the hand, 461.
Report of some interesting thoracic aneurysms, 90.
Technic of Radium Application in Cataracts, Isaac Levin, 107.
Teleroentgen method of determining size of soldiers' hearts, Abstract, 368.
Teleroentgenology of the Sella Turcica with Observations on 100 Normal Cases, E. Harvey Jewett, 352.
Tests of *X*-Ray Intensifying Screens, R. B. Wilsey, 196.
Thompson, Harold B., Disc attachment for Victor serial timer, 459.
Thoracic aneurysms, Report of some interesting, 90.
Three Years' Experience with Radium in Cancer of the Uterus, Ernest Charles Samuels, 42.
Thymus gland, malignant tumors of, treated by radium, 419.
Glands, enlarged, in infants, 191.
Thyroid and thymus glands, surgery of, Abstract, 221.
Metabolism, 229.
Topical Applications of Radium, H. H. Bowing, 582.
Traveling Foreign Body, E. C. Koenig, 327.
Treatment of Angiomata with Radium, William S. Newcomet, 337.
Of Cancer, Particularly of the Tongue, Tonsil and Rectum, by Buried Emanation, Henry H. Janeway, 92.
Of malignant tumors of the thymus gland by radium, Abstract, 419.
Of Pruritis Ani by *X*-Ray Radiation, William J. Young, 116.
Of Recurrences and Metastases from Carcinoma of the Breast by Means of Radium and Roentgen Rays, George E. Pfahler, 328.
True Congenital Hernia in the Right Diaphragm, D. Y. Keith, 289.
Tuberculosis of the genito-urinary tract, Diagnosis and treatment, Abstract, 622.
Surgical, of children, Radiotherapy in, Abstract, 275.
Tuberculous adenitis, Radium in the treatment of, Abstract, 124.
Tube stand, stereoscopic, for skull work, 564.
Turrell, Guy H., The aviators' heart. Roentgen rays under conditions simulating high altitudes, 67.
Twenty-first Annual Meeting, Address of Welcome, William J. Mayo, 575, Charles Mayo, 576.
Twenty-first Annual Meeting (see under "Editorial")
Tyler, A. F., Report of four cases of malignant disease successfully treated by roentgen therapy, 231.

Unfiltered and Filtered *X*-Ray Dosage, William D. Witherbee and John Remer, 485.
Unusual Gastric Polyp, Howard E. Ruggles, 356.
Upson, W. O., Notes on the roentgen treatment of leukemia, 608.
Urethroscopic injection of ejaculatory ducts with thorium, 16.
Urinary tract made opaque, Roentgen examination of, 584.
Urological diagnosis, Value of *x*-ray in, 403.
Useful Attachment to a Bowen Developing Tank, A. Judson Quimby, 345.
Use of Buried Emanation in the Treatment of Malignant Tumors, Henry H. Janeway, 325.
Uterine cancer, Three years' experience with radium in, 42.
Carcinoma, classified as to efficacy of radium therapy, 383.
Combination of roentgen rays and radium, 376.
Fibromyomata, The radiotherapy of, 30.

Value of the Roentgen Ray in the Study of Diverticulitis of the Colon. Arial W. George and Ralph D. Leonard, 421, 505.
Van Zwaluwenburg, James G., A plea for the use of the fluoroscope in the examination of the heart and great vessels, 1.
Ventriculography in localizing or eliminating cerebral tumors, Abstract, 466.
Vertebral fracture causing bony changes in feet, 125.
Victor serial timer, Disc attachment for, 459.

Waters, Charles A., *X*-Ray studies of the seminal vesicles and vasa deferentia after urethroscopic injection of the ejaculatory ducts with thorium, 16.
Watkins, W. Warner, The anomalous relation of roentgenology to medical practice, 531.
Wilsey, R. B., Tests of *x*-ray intensifying screens, 196.
Wilson, Louis B., Graduate education in roentgenology, 580.
Wilson, Robert, *X*-Ray work in the Canadian Expeditionary Force, 26.
Witherbee, William D., Unfiltered and filtered *x*-ray dosage, 485.
Word, A, to the Roentgen Therapeutist, C. Augustus Simpson, 357.

Xanthoma, Case of, showing multiple bone lesions, 480.
X-Ray (Poem), Helen Ashbury, 484.
Examination of chest, routine, disclosing diaphragmatic hernia, 247.
Generating outfits, Oil-immersed, 181.
Pre-operative and postoperative in carcinoma of the breast, 597.
Studies in Gout, E. D. McCarty, 451.
Of the Seminal Vesicles and Vasa Deferentia after Urethroscopic Injection of the Ejaculatory Ducts with Thorium; A New Diagnostic Method, Hugh J. Young and Charles A. Waters, 16.
Work in the Canadian Expeditionary Force, Robert Wilson, 26.
X-Rays in the Treatment of Fibromata and Uterine Hemorrhages, J. E. Panneton, 544.

Young, Hugh H., *X*-Ray studies of the seminal vesicles and vasa deferentia after urethroscopic injection of the ejaculatory ducts with thorium, 16.
Young, William J., Treatment of pruritis ani by *x*-ray radiation, 116.

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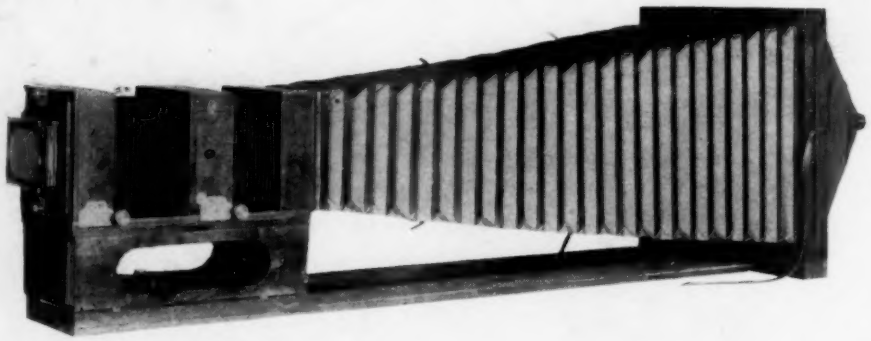

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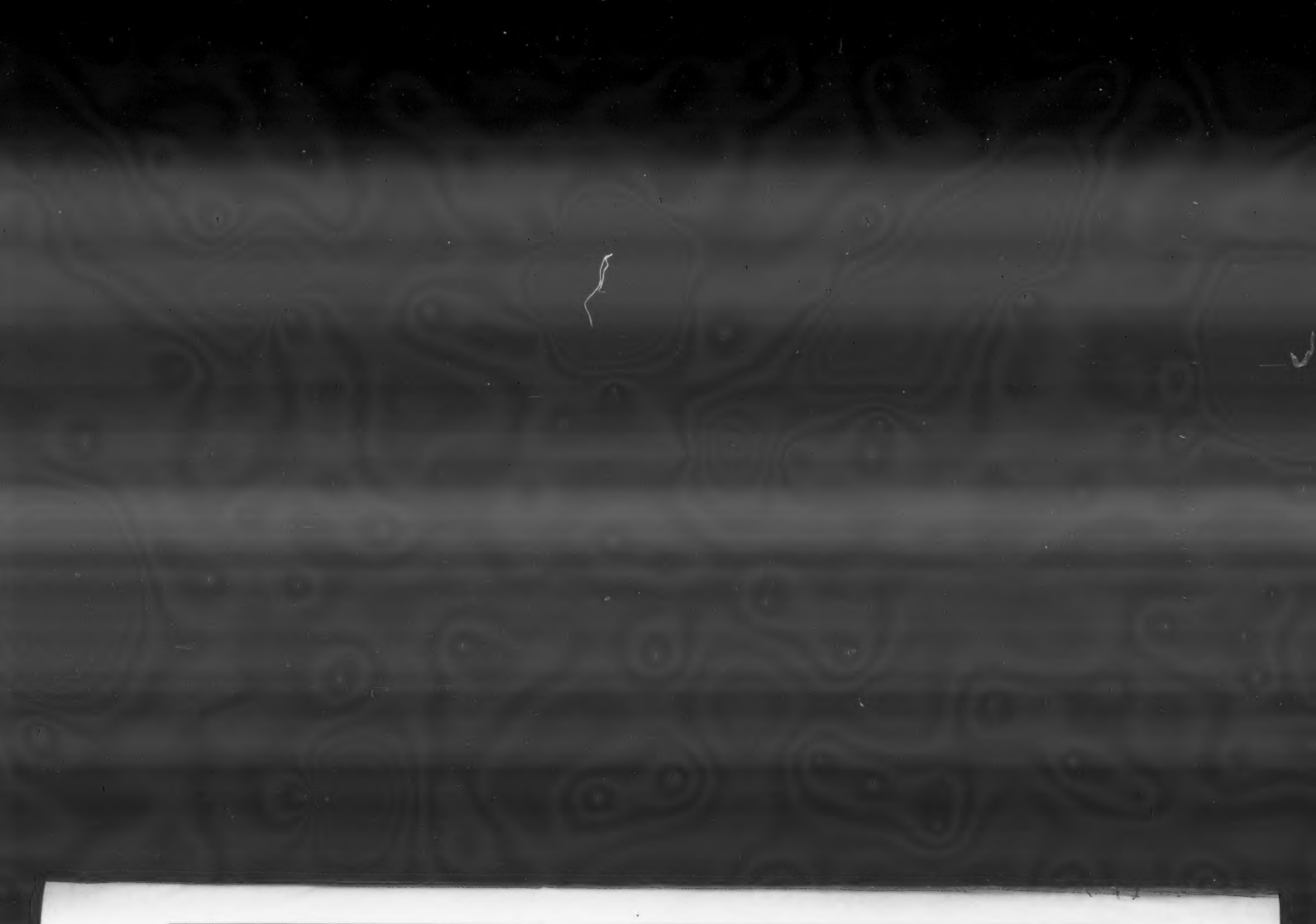
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